BULLETIN

DE LA

SOCIÉTÉ FOUAD I[er] D'ENTOMOLOGIE

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DU

VINGT-QUATRIÈME VOLUME

1940

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PUBLICATIONS DE LA SOCIETE

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DE LA

SOCIÉTÉ FOUAD I^er D'ENTOMOLOGIE

TRENTE-TROISIÈME ANNÉE

VINGT-QUATRIÈME VOLUME

1940

BULLETIN

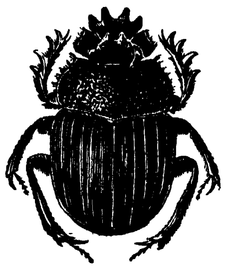
DE LA

SOCIÉTÉ FOUAD Ier D'ENTOMOLOGIE

FONDEE LE 1er AOUT 1907

anciennement:

Société Entomologique d'Egypte (1907-1922)
et ***Société Royale Entomologique d'Egypte*** (1923-1937)



Placee sous le Haut Patronage du Gouvernement Egyptien
par Décret Royal en date du 15 Mai 1923

Année 1940

LE CAIRE
IMPRIMERIE P. BARBEY
1940

Les opinions émises dans les publications de la Société sont propres à leurs auteurs. La Société n'en assume aucunement la responsabilité.

Date de parution et de distribution du présent Volume :
31 Décembre 1940

Le Rédacteur en Chef :
A. ALFIERI

DÉCRET DONNANT LE NOM DE
FOUAD PREMIER
A DES INSTITUTIONS PUBLIQUES CRÉÉES SOUS SES AUSPICES (1)

Nous, FAROUK Ier, Roi d'Egypte,

Sur la proposition du Président de Notre Conseil des Ministres tendant à perpétuer le souvenir de feu le Roi Fouad Premier et à glorifier son nom, vu que son règne s'est distingué par des œuvres éminentes dans le domaine des réformes et par la création de maintes institutions publiques dont la réalisation s'est accomplie grâce à ses conseils et à sa sollicitude, ce qui a eu la plus grande influence sur l'orientation et le développement de la renaissance scientifique, litteraire, sociale et économique de l'Egypte ;

Sur l'avis conforme de Notre Conseil des Ministres ;

DECRETONS

Art. 1. — Le nom de Fouad Premier est donné aux institutions et établissements indiqués au tableau annexé au présent décret. (2)

Art. 2. — Le Président de Notre Conseil des Ministres est chargé de l'exécution du présent décret, qui entrera en vigueur dès sa publication au « Journal Officiel ».

Fait au Palais de Montazah, le 11 Gamad Tani 1357 (7 Août 1938).

FAROUK

Par le Roi :

Le Président du Conseil des Ministres p.i.

ABDEL FATTAH YÉHIA

(Traduction)

(1) Extrait du *Journal Officiel* du Gouvernement Egyptien, N° 94, du Jeudi 11 Août 1938.

(2) Parmi les institutions et établissements indiqués au tableau annexé au présent décret, figure, sub 7 : *Société Fouad Ier d'Entomologie* **au lieu de** *Société Royale Entomologique d'Egypte.*

DÉCRET NOMMANT LE PRÉSIDENT DE LA SOCIÉTÉ FOUAD Ier D'ENTOMOLOGIE [1]

Nous, FAROUK Ier, Roi d'Egypte,

Vu le Décret du 15 Mai 1923 approuvant les Statuts de la Société Royale d'Entomologie d'Egypte (Société Fouad Ier d'Entomologie) ;

Sur la proposition du Président de Notre Conseil des Ministres et l'avis conforme du dit Conseil ;

DECRETONS

Art. 1. — Mahmoud Tewfik Hifnaoui Bey, Ministre de l'Agriculture, est nommé Président de la Société Fouad Ier d'Entomologie.

Art. 2. — Le Président de Notre Conseil des Ministres est chargé de l'exécution du présent décret.

Fait au Palais d'Abdine, le 6 Moharram 1359 (14 Février 1940).

FAROUK

Par le Roi :

Le Président du Conseil des Ministres,

ALY MAHER

(Traduction)

[1] Extrait du *Journal Officiel* du Gouvernement Egyptien, 67ème année, N° 18, du Lundi 19 Février 1940.

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1925 S.E. El Sayed Fathalla Mahmoud Pacha, de Rahmania (Béhéra).

» M. Riad Abdel Kawi El Gebali Bey, de Chebin El Kom (Menoufia).

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» S.E. Habib Chenouda Pacha, d'Assiout (Haute-Egypte).

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» M. Labib Barsoum Hanna Bey, de Minieh (Haute-Egypte).

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EN 1940

(Les noms des Membres Fondateurs sont précédés de la lettre F)

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1909 MARCHAL (Dr. Paul), 45, Rue de Verrières, à Antony (Seine), France.

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1908 PIC (Maurice), 3, Rue du Pont Neuf, à Digoin (Saône et Loire), France.

1921 PIERRE (Claude), 7 bis, Rue du Loing, Paris (XIVe), France.

1936 SEIF EL-NASR Pacha (S.E. AHMED HAMDI), Rue Khosro Pacha, Helouan, près le Caire.

1940 SILVESTRI (Prof. F.), Ecole Royale Supérieure d'Agriculture, Portici (Naples), Italie.

1929 THÉRY (André), Laboratoire d'Entomologie, Museum National d'Histoire Naturelle, 45 bis, Rue de Buffon, Paris (Ve), France.

1920 TONNOIR (André), Senior Research Officer, Division of Economic Entomology, Council for Scientific and Industrial Research, P.O. Box 109, Canberra, F.C.T., Australia.

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1932 ALFKEN (J.D.), 18, Delmestrasse, Brême, Allemagne.

» BALLARD (Edward), District Commissioner's Office, Jerusalem, Palestine.

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1923 HUSTACHE (A.), Pensionnat St. Laurent, à Lagny (Seine et Marne), France.

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1934 Koch (C.), c/o Monsieur Georges Frey, 18, Pienzenauerstrasse, Munich 27, Allemagne.

1929 Masi (L.), Museo Civico di Storia Naturale « Giacomo Doria », 9, Via Brigata Liguria, Genova (102), Italie.

1930 Mellor (J.E.M.), The Prospect Cottage, Bredwardine, Herefordshire, Angleterre.

1934 Paoli (Prof. Guido), Directeur du R. Osservatorio per le Malatie delle Piante, 1, Via Marcello Durazzo, Gênes, Italie.

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1927 Williams (C.B.), Rothamsted Experimental Station, Harpenden, Herts, Angleterre.

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1913 Abaza Pacha (S.E. Fouad), Boîte Postale N° 63, au Caire.

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1938 Bailey Bros and Swinfen Ltd., Cathedral House, 8-11, Paternoster Row, Londres, E.C. 4, Angleterre.

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1935 GLYKI (Marc), Ingénieur-Chimiste, Bureau Technique Agricole et Industriel, 2, Rue du Télégraphe Anglais, Alexandrie.

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1932 HIS MAJESTY STATIONERY OFFICE, Princes Street, Westminster, S.W.1, London, Angleterre.

1925 HOCHEIRY Bey (Abd-El-Baki Zaki El), ancien Conseiller à la Cour d'Appel Indigène, 22, Rue Abou el Feda, Zamalek, au Caire.

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1940 IBRAHIM (Ahmed Housny), Section d'Entomologie, Ministère de l'Agriculture, Dokki (Gkizeh), près le Caire.

1936 IMPERIAL CHEMICAL INDUSTRIES (EGYPT) S.A., 26. Rue Madabegh, au Caire.

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1923 LABORATOIRES D'HYGIÈNE PUBLIQUE, Bibliothèque de la Section d'Helminthologie, au Caire.

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1934 LOTTE (Dr. F.), Médecin de la Compagnie Universelle du Canal Maritime de Suez, Boîte Postale N° 222, Port-Saïd.

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1929 MOSSERI (Henri), 25, Rue Cheikh Abou El Sebaa, au Caire.

1940 NOUR EL DIN (Ahmed), Section d'Entomologie, Ministère de l'Agriculture, Dokki (Ghizeh), près le Caire.

1939 PANTOS (Jean), Ingénieur Agronome, Abou Kerkas, Haute-Egypte.

1911 PETROFF (Alexandre), 27, Rue Grafton, Bulkeley, Ramleh.

1928 PRIESNER (Prof. Dr. H.), Directeur de la Section d'Entomologie Ministère de l'Agriculture, Dokki (Ghizeh), près le Caire.

1932 RIVNAY (E.), Agricultural Research Station, Rehovoth, Palestine.

1925 ROYAL ENTOMOLOGICAL SOCIETY OF LONDON (The), 41, Queen's Gate, South Kensington, S.W. 7, Londres, Angleterre.

1938 RUNKEWITZ (G.), Savoy Hotel, Louxor, Haute Egypte.

1936 SAYED (Dr. Mohamed Taher), Section d'Entomologie, Ministère de l'Agriculture, Dokki (Ghizeh), près le Caire.

1938 SHAFEI (Mohamed Aly Ismail El), 18, Midan Mohamed Aly, au Caire.

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1924 SHAW (Fred), Northgate, Sherborne, Dorset, Angleterre.

1938 SOCIÉTÉ DU NAPHTE S.A. (A.I. Mantacheff & Co.), 1, Rue de l'Eglise Debbané, Alexandrie.

1921 SOCIÉTÉ ROYALE D'AGRICULTURE, Laboratoire d'Entomologie de la Section Technique, Boîte Postale N° 63, au Caire.

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1928 SOLIMAN (Dr. Labib Boutros), Section d'Entomologie, Ministère de l'Agriculture, Dokki (Ghizeh), près le Caire.

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1926 WALY (Dr. Mohamed), Conférencier en Zoologie, Faculté des Sciences, Université Fouad Ier, Abbassieh, au Caire.

1912 WILKINSON (Richard), Immeuble Baehler, 157, Avenue Fouad Ier, Zamalek, au Caire.

1940 ZAKI (Michel), Section d'Entomologie, Ministère de l'Agriculture, Dokki (Ghizeh), près le Caire.

1938 ZOHEIRY (Mohamed Soliman El), Sous-Directeur et Directeur p.i. de la Section d'Entomologie, Ministère de l'Agriculture, Dokki (Ghizeh), près le Caire.

1926 ZULFICAR Bey (Samir), 8, Rue Mohamed Mazhar Pacha, Zamalek, au Caire.

Institutions Scientifiques et Bibliothèques

Afrique Occidentale Française:

Institut Français d'Afrique Noire, Boîte Postale N° 206, Dakar.

Afrique du Sud:

South African Museum, P.O. Box 61, Cape Town.

Department of Agriculture of the Union of South Africa (The Agricultural Journal of the Union of South Africa), Pretoria.

Department of Agriculture of the Union of South Africa, Division of Entomology, P.O. Box 513, Pretoria.

The Director, The Transvaal Museum, P.O. Box 413, Pretoria, South Africa.

The Honorary Secretary, Entomological Society of Southern Africa, P.O. Box 103, Pretoria.

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Société d'Histoire Naturelle de l'Afrique du Nord, Faculté des Sciences d'Alger, Alger.

Allemagne:

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Senckenbergischen Naturforschenden Gesellschaft, Bibliothek, Viktoria Allee 9, Frankfurt A/M.

Bücherei des Zoologischen Museums, 43, Invalidenstrasse, Berlin N 4.

Gesellschaft für Vorratsschutz E.V. (Mitteilungen der), 31, Zimmermannstrasse, Berlin-Steglitz.

Bücherei der Biologischen Reichsanstalt für Land- und Forstwirtschaft. 19, Königin-Luise-Str., Berlin-Dahlem.

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Deutsche Kolonial und Uebersee-Museum, Bahnhofsplatz, Brême.

Administration-Kanzlei des Naturhistorischen Museums, Burgring 7, Vienne (I).

Zoologisch-Botanische Gesellschaft, 2, Mechelgasse, Vienne (III).

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Angleterre :

The Imperial Institute of Entomology, Review of Applied Entomology, 41, Queen's Gate, London S.W. 7.

Zoological Museum (Novitates Zoologicæ), Tring Park, Tring, Herts.

The Apis Club (The Bee World), The Way's End, Foxton, Royston, Herts.

Cambridge Philosophical Society, New Museums, Free School Lane, Cambridge.

The Librarian, The Zoological Society of London, Zoological Gardens, Regent's Park, London, N.W.8.

The Librarian, Department of Entomology, University Museum, Oxford.

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Instituto Biologico de la Sociedad Rural Argentina, Buenos Aires.

Sociedad Cientifica Argentina, 1145, Calle Santa Fé, Buenos Aires.

Sociedad Entomologica Argentina, 665, Calle San Martin, Buenos Aires.

Museo Nacional de Historia Natural « Bernadino Rivadavia », Casilla de Correo N° 470, Buenos Aires.

Ministerio de Agricultura (Boletin del Ministerio de Agricultura de la Nacion), Bibliotheca, 974, Paseo Colon, Buenos Aires.

Australie :

The Australian Museum (Records of the Australian Museum), Sydney, N.S.W.

The Entomologist's Office, Department of Agriculture, Sydney, N.S.W.

The Public Library, Museum, and Art Gallery of South Australia, Box 386 A, G.P.O., Adelaide, South Australia.

The Library of the Division of Economic Entomology, P.O. Box No. 109, Canberra City, F.C.T.

The Linnean Society of New South Wales, Science House, Gloucester and Essex Streets, Sydney, N.S.W.

Belgique:

Société Entomologique de Belgique, Musée Royal d'Histoire Naturelle de Belgique, 31, Rue Vautier, Ixelles-Bruxelles.

Société Scientifique de Bruxelles, Secrétariat, 11, Rue des Récollets Louvain.

Monsieur A. Moureau, Secrétaire du Bulletin de l'Institut Agronomique et des Stations de Recherches de Gembloux, Institut Agronomique de l'Etat, Gembloux.

Lambillionea, Revue Mensuelle de l'Union des Entomologistes Belges (M. F. Derenne), 123, Avenue de la Couronne, Ixelles (Bruxelles).

Annales du Musée du Congo Belge, Tervueren.

Association des Ingénieurs sortis de l'Institut Agronomique de l'Etat, à Gembloux, 35, Avenue des Volontaires, Anderghem-Bruxelles.

Brésil:

Museu National do Rio de Janeiro, Rio de Janeiro.

Instituto Biologico, Bibliotheca, Caixa Postal 2821, São Paulo.

Instituto Oswaldo Cruz, Caixa de Correio 926, Rio de Janeiro.

Arquivos do Serviço Florestal, 1008, Jardim Botânico, Rio de Janeiro.

Bulgarie:

Institutions Royales d'Histoire Naturelle, Musée Royal d'Histoire Naturelle, Palais Royal, Sofia.

Société Entomologique de Bulgarie, Musée Royal d'Histoire Naturelle, Palais Royal, Sofia.

Société Bulgare des Sciences Naturelles, Musée Royal d'Histoire Naturelle, Palais Royal, Sofia.

Canada:

Entomological Society of Ontario (The Canadian Entomologist & Reports), Guelph, Ontario.

Bibliothèque du Ministère Fédéral de l'Agriculture, Edifice de la Confédération, Ottawa.

Department of Agriculture, Entomological Branch, Ottawa.

Nova Scotian Institute of Science, Halifax.

Chine:

The Lingnan Science Journal, Lingnan University, Canton.

Bulletin of the Biological Department, Science College, National Sun Yat-Sen University, Canton.

Bureau of Entomology of the Chekiang Province, West Lake, Hangchow.

Chypre:

The Cyprus Agricultural Journal (The Office of the Governement Entomologist), Nicosia.

Colombie (République de), Amérique du Sud :

Revista Facultad Nacional de Agronomia, Biblioteca Facultad Nacional de Agronomia, Universitad Nacional, Medellin.

Cuba:

Sociedad Cubana de Historia Natural « Felipe Poey » (Memorias), c/o Dr. Carlos Guillermo Agnayo, 25 N° 254, Vedado, La Havane.

Danemark:

Entomologisk Forening, Zoologisk Museum, Krystalgade, Copenhague.

Egypte:

Bibliothèque du Cabinet de S.M. le Roi, Palais d'Abdine, au Caire.

Bibliothèque privée de S.M. le Roi, Palais d'Abdine, au Caire.

Ministère de l'Agriculture, Bibliothèque de la Section d'Entomologie, Dokki (Ghizeh), près le Caire.

Société Royale d'Agriculture, Bibliothèque de la Section Technique, Boîte Postale N° 63, au Caire.

Union des Agriculteurs d'Egypte, 25, Rue Cheikh Abou El Sebaa, au Caire.

The Bee Kingdom, 60, Rue Menasce, Alexandrie.

Al-Fellaha, Boîte Postale N° 2047, au Caire.

Société Royale de Géographie d'Egypte, 45, Rue Cheikh Youssef, au Caire.

. Bibliothèque du Ministère de l'Instruction Publique, Rue El Falaki, au Caire.

The Journal of the Egyptian Medical Association, Kasr El Aini Post Office, au Caire.

Société Fouad I^er^ d'Economie Politique, de Statistique et de Législation, Boîte Postale N° 732, au Caire.

Institut d'Egypte, Rue Sultan Hussein (ex Rue El Cheikh Rihan), au Caire.

Bibliothèque Egyptienne, Midan Bab El Khalq, au Caire.

Bibliothèque du Musée Agricole Fouad I^er^, Dokki (Ghizeh), près le Caire.

Bibliothèque de la Faculté de Médecine, Université Fouad I^er^, Rue Kasr El Aini, au Caire.

Bibliothèque de la Faculté des Sciences, Université Fouad I^er^, Abbassieh, au Caire.

Equateur (République de l'), Amérique du Sud:

Director General de Agricultura (Revista del Departamento de Agricultura), Quito.

Boletin de la Seccion Agricola del Banco Hipotecario del Ecuador, Apartado 685, Quito.

Espagne:

Instituto Nacional de 2ª Ensenanza de Valencia, Laboratorio de Hidrobiologia Espanola, Valencia.

Junta para ampliacion de Estudios e Investigaciones Cientificas, 4, Duque de Medinaceli, Madrid.

Junta de Ciencies Naturales de Barcelona, Museo Municipal, Barcelona.

Real Academia de Ciencias y Artes de Barcelona, 9, Rambla de los Estudios, Barcelona.

Sociedad Espanola de Historia Natural, Museo Nacional de Ciencias Naturales, Hipodromo, Madrid (VI).

Estacion de Patologia Vegetal, Instituto Nacional Agronomico, La Monclea, Madrid (VIII).

Etats-Unis:

The Research Library, Buffalo Socicety of Natural Sciences, Buffalo Museum of Science, Humboldt Park, Buffalo, New-York.

University of Illinois Library, Exchange Division, Urbana, Illinois.

Library of the American Museum of Natural History, Central Park, West at 79th Street, New-York City.

Pacific Coast Entomological Society (The Pan-Pacific Entomologist), California Academy of Sciences, Golden Gate Park, San Francisco, California.

Academy of Natural Sciences, Entomological Section, Lagon Square, Philadelphia.

Experiment Station of the Hawaiian Sugar Planters' Association, P.O. Box 411, Honolulu, T.H., Hawai.

Hawaiian Entomological Society, c/o Experiment Station of the Hawaiian Sugar Planters' Association, P.O. Box 411, Honolulu, T.H., Hawai.

Carnegie Museum, Department of the Carnegie Institute, Pittsburgh, Pennsylvania.

American Entomological Society, Academy of Natural Sciences, Logan Square, Philadelphia, Pa.

United States Department of Agriculture, Washington, D.C.

General Library, University of Michigan, Ann Arbor, Michigan.

United States National Museum, Smithsonian Institution, Washington, D.C.

Smithsonian Institution Library, Washington, D.C.

Library of the New-York State College of Agriculture and Agricultural Experiment Station, Cornell University, Ithaca, New-York.

New-York Academy of Sciences, New-York.

Pennsylvania State Health Department, Pennsylvania.

University of California Library, Berkeley, California.

University of California, Citrus Experimental Station Library, Riverside, California.

Wisconsin Academy of Sciences, Arts, and Letters, Madison, Wisconsin.

Library, Minnesota Agricultural Experiment Station, University Farm, Saint Paul, Minnesota.

Museum of Comparative Zoology, Harward College, Cambridge, Mass.

The Philippine Agriculturist, Library, College of Agriculture, Agricultural College, Laguna, Philippine Islands.

Editorial Office, The American Midland Naturalist, University of Notre Dame, Notre Dame, Indiana.

Marine Biological Laboratory, Library, Woods Hole, Mass.

Finlande:

Societas Entomologica Helsingforsiensis, Helsinki.

Societas pro Fauna et Flora Fennica, Kaserngatan 24, Helsinki.

Societas Zoologica-Botanica Fennica Vanamo, Säätytalo, Snellmanstr. 9-11, Helsinki.

Société Entomologique de Finlande (Annales Entomologici Fennici), Institut de Zoologie Agricole et Forestière de l'Université, Snellmaninkatu 5, Helsinki.

France:

L'Echange, Revue Linnéenne, Digoin (Saône et Loire).

Revue française d'Entomologie, Museum National d'Histoire Naturelle (Entomologie), 45 bis, Rue de Buffon, Paris (V^{e}).

Revue Scientifique du Bourbonnais et du Centre de la France, 22, Avenue Meunier, Moulins (Allier).

Société d'Etudes des Sciences Naturelles de Nîmes, 6, Quai de la Fontaine, Nîmes (Gard).

Société de Pathologie Végétale et d'Entomologie Agricole de France, Laboratoire de Pathologie Végétale, Institut National Agronomique, 16, Rue Claude Bernard, Paris (V^{e}).

Société Linnéenne de Bordeaux, Athénée, 53, Rue Des Trois Conils, Bordeaux.

Société Linéenne de Lyon, 33. Rue Bossuet (Imm. Municipal), Lyon.

Société des Sciences Naturelles de l'Ouest de la France, Nantes (Loire Inférieure).

Association des Naturalistes de Levallois-Perret, 153, Rue du Président Wilson (Domaine de la Planchette), Levallois-Perret (Seine).

Société Linnéenne du Nord de la France, 81, Rue Lemerchier (M. Pauchet), Amiens.

Société Géologique de Normandie et des Amis du Museum du Havre, Hôtel des Société Savantes, 56, Rue Anatole France, Le Havre (Seine Inférieure).

Société d'Histoire Naturelle de Toulouse, Bibliothèque Universitaire de la Faculté de Médecine, Allée Saint-Michel, Toulouse.

Société Entomologique de France, Institut National Agronomique, 16, Rue Claude Bernard, Paris (Ve).

Société d'Etudes Scientifiques de l'Aude, Carcassone (Aude).

Annales des Epiphyties et de Phytogénétique, Centre National des Recherches agronomiques, à Versailles, France.

Museum National d'Histoire Naturelle, Bibliothèque, 8, Rue de Buffon, Paris (Ve).

Société de Zoologie Agricole (Revue de Zoologie Agricole et Appliquée), Faculté des Sciences, Institut de Zoologie, 40, Rue Lamartine, Talence (Gironde).

Grèce:

Institut Phytopathologique Benaki, Kiphissia (près Athènes).

Bibliothèque de l'Institut et Musée Zoologique de l'Université, Athènes.

Hollande:

Bibliotheek van der Nederlandsche Entomologische Vereeniging, p/a Bibliotheek van het Kolonial Instituut, 62, Mauritskade, Amsterdam.

Landbouwhoegeschool Laboratorium voor Entomologie, Berg 37, Wageningen.

Hongrie:

Museum National Hongrois (Annales Historico-Naturales), 13, Baross-utca, Budapest VIII.

Indes :

Zoological Survey of India (Records of the Indian Museum), Indian Museum, Calcutta.

Madras Governement Museum, Connemara Public Library, Egmore, Madras.

Office of the Director, Imperial Agricultural Research Institute, New Delhi.

Indes Néerlandaises :

Bibliotheek van het Departement van Economische Zaken, Groote Weg 20, Buitenzorg, Java.

Italie :

Museo Civico di Storia Naturale « Giacomo Doria », 9, Via Brigata Liguria, Genova (102).

Rivista di Biologia Coloniale, 326, Viale Regina Margherita (Policlinico), Roma.

Museo Civico di Storia Naturale di Trieste (Atti del), 4, Piazza Hortis, Trieste (10).

Società dei Naturalisti in Napoli, Reale Università, Via Mezzocannone, Napoli.

Società Entomologica Italiana, Museo Civico di Storia Naturale, 9, Via Brigata Liguria, Genova (102).

Società Adriatica di Scienze Naturali, 7, Via dell'Annunziata, Trieste.

La Reale Stazione di Entomologia Agraria (Redia), 19, Via Romana, Firenze (32).

La Reale Stazione Sperimentale di Gelsicoltura e Bachicoltura di Ascoli Piceno.

Istituto Zoologico della Reale Università di Napoli (Biblioteca del), Via Mezzocannone, Napoli.

Laboratorio di Zoologia Generale e Agraria del Reale Istituto Superiore Agrario in Portici, Portici (Napoli).

Reale Laboratorio di Entomologia Agraria di Portici (Bolletino del), Portici (Napoli).

Bibliothèque de l'Institut International d'Agriculture (Moniteur International de la Protection des Plantes), Villa Umberto I, Rome (110).

Società italiana di Scienze Naturali, Palazzo del Museo Civico di Storia Naturale, Corso Venezia, Milano.

Istituto di Zoologia della Reale Università di Genova (Bollettino dei Musei di Zoologia e di Anatomia comparata), 5, Via Balbi, Genova.

Società dei Naturalisti e Matematici di Modena, presso la Reale Università, Modena.

Istituto di Entomologia della Reale Università, 6, Via Filippo Re, Bologna (125).

Reale Accademia di Scienze, Lettere ed Arti in Padova, 15, Via Accademia, Padova (Veneto).

Museo di Storia Naturale della Venezia Tridentina (« Memorie del Museo di Storia Naturale della Venezia Tridentina » e « Studi Trentini di Scienze Naturali »), Casella Postale 95, Trento.

Reale Istituto Agronomico per l'Africa Italiana (L'Agricoltura Coloniale), Ministero dell'Africa Italiana, 9, Viale Principe Umberto, Firenze.

Istituto di Entomologia Agraria e Bachicoltura della Reale Università (Bolletino di Zoologia Agraria e Bachicoltura), 2, Via Celoria, Milano (133).

Società Veneziana di Storia Naturale (presso Sig. Antonio Giordani Soika), S. Marco 254, Venezia.

Japon :

Saghalien Central Experiment Station, Konuma, Saghalien.

The Ohara Institute for Agricultural Research, Library, Kurashiki, Okayama-Ken.

Imperial Agricultural Experiment Station (Journal of the), Nishigahara, Tokyo.

Departement of Agriculture, Government Research Institute, Taihoku, Formosa.

The Kansai Entomological Society, c/o N. Tosawa, Shibakawa-Noen, Kotoen, Mukogun, Hyogo-ken.

« Mushii », Entomological Laboratory, Department of Agriculture, Kyushu Imperial University, Fukuoka.

Takeuchi Entomological Laboratory (Tenthredo, Acta Entomologica), Shinomyia Yamashina, Kyoto.

Kenya:

East Africa and Uganda Natural History Society, Coryndon Memorial Museum, P.O.Box 658, Nairobi, Kenya Colony, British East Africa.

Libye:

Museo Libico di Storia Naturale, Piazza Santa Maria degli Angeli, Tripoli d'Africa.

Maroc:

Société des Sciences Naturelles du Maroc, Institut Scientifique Chérifien, Avenue Biarnay, Rabat.

Défense des Végétaux, Service de l'Agriculture et de la Colonisation, Direction des Affaires Economiques, Rabat.

Mexique:

Junta Nacional Directora de la Campana contra la Langosta (Junosta), Biblioteca, Departamento Directivo, Veracruz.

Biblioteca del Instituto Biotecnico, Calzada Mexico-Tacuba N° 295, Col. Anahuac, D.F.

Biblioteca del Instituto de Biologia, Chapultepec (Casa del Lago), Mexico, D.F.

Anales de la Escuela Nacional de Ciencias Biologicas, Apartado Postal 7016, Mexico, D.F.

Norvège:

Tromso Museum Library, Tromso.

Panama (République de):

Departamento Seccional de Agricultura (Boletin Agricola), Panama.

Pologne:

Musée Zoologique Polonais, Wilcza 64, Varsovie (1).

Société Polonaise des Entomologistes, Rutowskiego 18, Lwow.

Institut de Recherches des Forêts de l'Etat, Wawelska 54, Varsovie.

Portugal :

Société Portugaise des Sciences Naturelles, Instituto de Fisiologia, Faculdade de Medicina, Lisbonne.

Museum Zoologique de l'Université de Coimbra, Largo Marquês de Plombal, Coimbra.

Associçao da Filosofia Natural, na Faculdade de Ciencias, Porto.

Roumanie :

Société Transylvanienne des Sciences Naturelles (Siebenbürgischer Verein für Naturwissenschaften), Hermannstadt, Sibiu.

Academia Romana, Bibliothèque, Calea Victoriei, 125, Bucarest.

Russie (U.S.S.R.) :

Société Entomologique de Russie (Revue Russe d'Entomologie et Horae), Musée Zoologique de l'Académie des Sciences, Léningrad.

Bibliothèque de l'Académie des Sciences de l'Ukraine, 58a, Rue Korolenko, Kiew (Ukraine).

Société des Naturalistes de Kiew, 37-10, Rue Korolenko, Kiew (Ukraine).

Institut des Recherches Biologiques de l'Université de Perm, Perm II, Zaimka.

Institute for Plant Protection, Bureau of Applied Entomology and Zoology, Library, 10, Elagin Ostrov, Léningrad.

Rédaction du Journal « Plant Protection », 7, Rue Tschaikovsky, Leningrad.

Institute for controlling Pests and Diseases, Library, 7, Tschaikovsky Str., Leningrad 28.

Siam :

Department of Agriculture and Fisheries, Entomology Section, Bangkok.

Suède :

K. Swenska Vetenskapsakademien i Stockholm, Stockholm 50.

Entomologiska Foreningen, Brottninggatten 94, Stockholm.

Göteborgs Kungl. Vetenskaps-och Vitterhets Samhälles, Göteborg.

Statens Växtskyddsanstalt, Stockholm 19.

Bibliothèque de l'Université de Lund, Lund.

Suisse :

Bibliothèque de la Société Entomologique Suisse, Musée d'Histoire Naturelle, Berne.

Zentralbibliotek, Naturforschenden Gesellschaft, Zurich.

Tchoco-Slovaquie :

Societas Entomologica (Casopis), u Karlova 3, Prague II.

Section Entomologique du Musée National de Prague (Sbornik), Prague II-1700.

Bibliothèque de la Société Zoologique Tchécoslovaque, Institut de Zoologie, Karlov 3, Prague II.

Uruguay (République de l') :

Escuela de Veterinaria del Uruguay (Anales de la Escuela de Veterinaria del Uruguay), Itazaingo 1461, Montévideo.

Sociedad de Biologia de Montevideo, Casilla de Correo 567, Montevideo.

Yougo-Slavie :

Societas Entomologica Jugoslavica (Glasnik), 17, Garasaninovo ulica, Belgrade.

Abonnements de la Société

The Transactions and Proceedings of the Royal Entomological Society of London.

The Macrolepidoptera of the World, édité par le Dr. A. Seitz (suspendu depuis Juin 1937).

Coleopterorum Catalogus, édité par W. Junk - S. Schenkling (suspendu depuis Août 1937).

N.B. — Pour changement d'adresse, erreurs ou omissions, s'adresser à Monsieur le Secrétaire Général de la Société Fouad I[er] d'Entomologie, Boîte Postale N° 430, au Caire.

Séance du 24 Janvier 1940

Présidence de S.E. FOUAD ABAZA Pacha

Nécrologie :

Le Secrétaire Général a le regret d'annoncer le décès de SAID BAHGAT Bey, survenu le 5 Janvier.

SAID BAHGAT Bey faisait partie de la Société depuis 1928. En 1936, il avait été élu membre de notre Conseil d'Administration. Avec la mort de ce distingué collègue, la Société perd un de ses membres des plus dévoués.

Est également annoncée la mort du Dr. EDOUARD BUGNION, membre honoraire de la Société dès sa fondation. Le Dr. BUGNION avait largement contribué aux travaux de la Société par ses nombreuses études publiées dans nos Bulletins.

Don à la Bibliothèque :

Messieurs le Docteur M. WALY, A. H. AL-HUSSAINI et M. HAFEZ ont fait parvenir un exemplaire de leur travail intitulé « Dissection and Histology of the Egyptian Toad », publié au Caire, en 1939 (première édition).

Le Conseil remercie.

Echange de Publications :

La REVISTA FACULTAD NACIONAL DE AGRONOMIA, de Medellin, République de Colombie, se fait inscrire sur notre liste des échanges.

Admission :

Monsieur MOHAMED IBRAHIM NOUR EL DIN, de la Faculté d'Agriculture, Université Fouad I^er^, proposé par Messieurs ABDEL AZIZ LOUTFY et A. ALFIERI, est admis à faire partie de la Société en qualité de membre titulaire.

The larva of *Trinodes flavus* Motsch.

[Coleoptera . Dermestidae]

(with 5 Text-Figures)

by Prof. Dr. H. PRIESNER

On examining fallen leaves under hedges composed of *Clerodendron inermis* and *Bougainvillea*, at Montazah near Alexandria, I found as one of the more common insects living in the detritus under the hedges, a small, globiform larva, measuring from 1.5 to 2 mm., being of a brownish colour with ochrous head, and very hairy. I thought it belonging to the *Dermestidae* or *Ptinidae* but was unable to place it, as I had never before seen anything similar.

About a dozen of the specimens were brought to Cairo, and placed in a small dish for the purpose of breeding them, and thus ascertaining the species. I fed the larvae with dead house-flies; a few of the larvae finally pupated (after about a fortnight), and within another week specimens of *Trinodes flavus* Motsch. emerged.

I am not certain whether the larvae feed on dead insects also in the open but I suppose so, as the high mortality observed under laboratory conditions may very well be ascribed but to lack of humidity in the watch-glasses wherein they were bred.

A close description of the larva I consider superfluous, as the figures, given by B. Assaad Eff. show most of the characteristic details, particularly the most peculiar hairs or bristles. There are three main types of bristles on the body — on all segments excepting the head —, two of them (Figs. 2 and 3) more or less of the shape of a twig with needles of the *Araucaria* tree; the third type (Fig. 4) is smaller and finer, with blunt, hooked tip. Another bristle-type is present on the legs, similar to that shown in Fig. 3 but smaller, and not widened towards tip, slightly plumose, pointed, and hollow within, nearly throughout its length. The bristles as shown in Fig. 2 are about 0.3 mm. long, those as in Fig. 3 attain 0.600-0.675 mm., whilst the brirstle-type illustrated in Fig. 4, i.e. the hooked bristles are about 0.3-0.4 mm. long; those on the legs vary greatly in length (0.07-0.10 mm.) but are much smaller than the others.

In large specimens, the head is 0.47 mm. long and 0.50 mm. broad; there are 2+2 ocelli at the sides, and the antennae are very small, 2-jointed, with a stout sense-cone at the apex of joint 1; head above with scattered

hairs which are fine, somewhat curved, and plumose, when seen under high magnification. Mandibles with blunt teeth; maxillary palpi 4-5-jointed, terminal joint 36-39 μ long, the preceeding joints short, transverse.

Legs fairly long, claw long and somewhat curved, that of the fore leg about 75 μ in length.

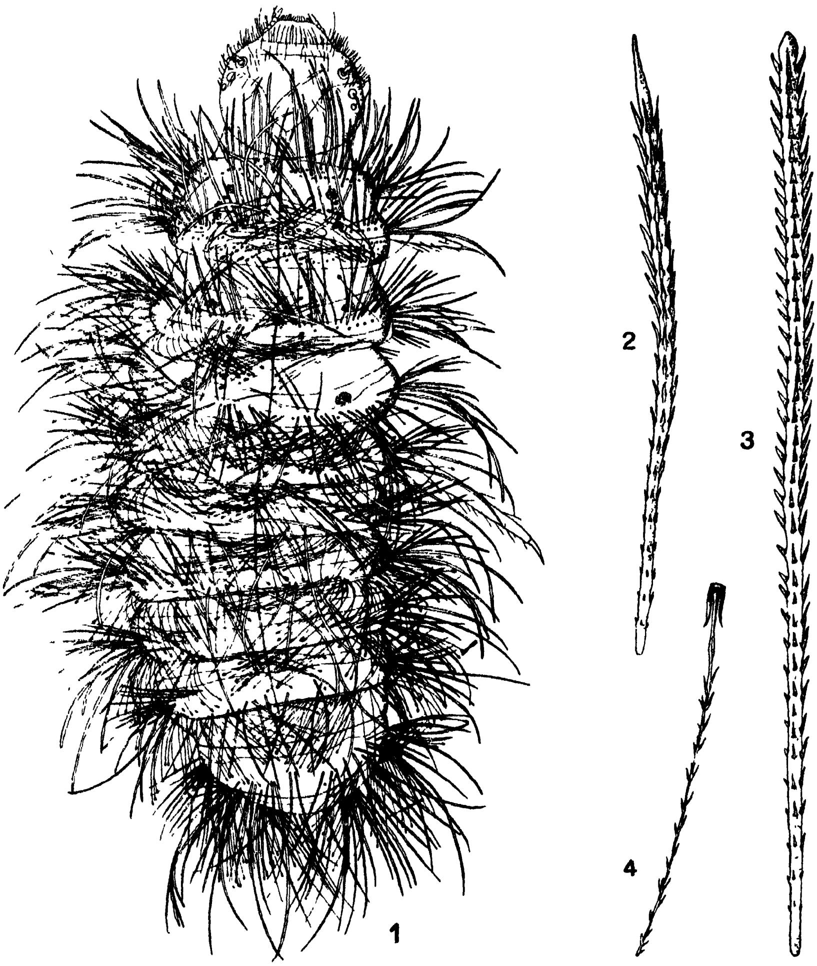


Fig. 1. — Full grown larva of *Trinodes flavus* Motsch (from a microscopic balsam-mount; distended) — × 8.25.
Figs. 2-4. — Three main types of bristles occuring on *Trinodes flavus* Motsch. larva.

The shape of the body is much more compact in the living specimens than shown in Fig. 1, as this figure is purposely based on a somewhat dis-

tended example of a microscopic mount; the living insect is short and strongly convex, almost globiform. The dorsum of the segments is somewhat more strongly chitinized transversally, and particularly the fore margin of the tergites is marked by a dark line. The pronotum is longer than the remaining segments, and about trapezoidal in shape; from above, seven abdominal

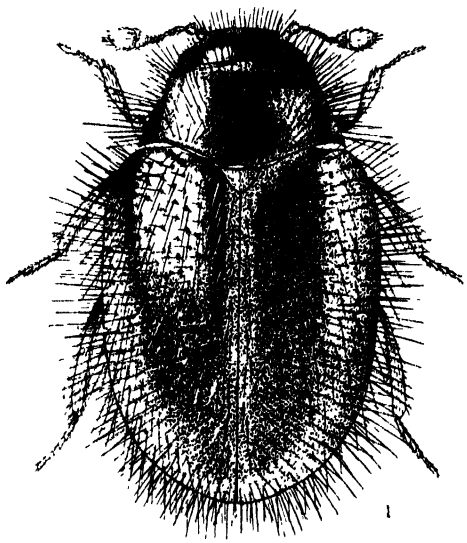


Fig. 5 *Trinodes flavus* Motsch.: adult. — × 42.

segments are discernible, the ultimate of which is broadly and evenly rounded.

Pupation took place inside the chitinous remains of the bodies of the flies given as food, and the pupa would rest — as it is the case with *Anthrenus* and other *Dermestidae* — inside the last larval exuvia.

Trinodes is a small genus, composed of but 6 Palaearctic species :

The common European *Trinodes hirtus* F., of which Ganglbauer said to have found it in the webs of the house-spider (*Tegenaria*) feeding on the dead remains of insects left by the spider in its net. From Algeria, Pic described *Trinodes curtus*.

Trinodes flavus Motsch. and *Trinodes bicoloratus* Pic are described from Egypt, and are recorded from this country only. *Trinodes flavus* Motsch. occurs not only in the northern coastal region (Mariout, Alexandria, Port-Said) but also in the latitude of Cairo, as Alfieri's and Rabinovitch's collections contain a number of specimens from El-Marg, Kubbah, Barrage and Helwan.

As to *Trinodes bicoloratus* Pic, a single specimen was found at Tamyia (Fayoum) on 13.III.1934, the description of which is given in Bulletin de la Société Fouad I[er] d'Entomologie, 1939, p. 144, and the type preserved in Alfieri's collection.

The two remaining species of the Palaearctic occur in China and Japan

A New Species of *Sarcophaga* from Egypt with a Note on the Male Hypopygium of *Sarcophaga Kadeisi* Salem

[Diptera: Sarcophagidae]

(with 2 Text-Figures)

by Hassan Hilmy Salem, M.B., M.Sc.,
Ph. D. (Fouad 1st University), D.T.M. and H. (England),
of the
Parasitology Department, Faculty of Medicine, Cairo.

Sarcophaga Tewfiki nov. spec. (♂)

Length about 8 to 9 mms. Frons is half the width of the eye. Frontal stripe black with golden reflections posteriorly. About eight frontal crossed bristles are present. Parafrontals grey with dark and gold reflections. Measured at the level of the first frontal pair of crossed bristles each equals about one fifth of the width of the frontal stripe. Parafrontalia with a very weak row of short hairs. Postoculars in two rows but on the median occipital region there are three rows. Second antennal segment dark but with marked orange reflections. Third antennal segment entirely dark and is two and half times as long as the second segment. Arista is one and a quarter as long as the third antennal segment. Maxillary palps club-shaped, mainly black, apex with golden reflections and is very slightly shorter than the arista. Antennae occupy nearly 4/5th of the distance between antennal roots and epistome. *Thorax* greenish grey with three black longitudinal stripes Only one pair of posterior acrostichals and two pairs of posterior dorso-centrals are present. Crossed scutellar apicals present. Rest of the bristles on the dorsal surface like other species. Propleura bare. Sternopleurals 2.1. Hypopleuron with the usual fan-shaped tuft of bristles. *Legs* all bare with the exception of a small ventral tuft of hairs and the macrochaetal row on the hind femorae Mid femorae without a well developed comb of spines. Mid tibiae with an antero-ventral bristle.

Wings : Costal bristle moderately developed. Third costal section slightly less than one and half times as long as the fifth section. First longitudinal vein bare, third longitudinal with few bristles.

Abdomen : Shimmering in colour with black, pale greenish-grey and silvery reflections. Third segment without any median marginals. Fourth abdominal segment with one pair of central posterior marginal bristles. Fifth segment with the usual row of bristles. Abdominal sternites with long soft hairs. A peculiar patch of few very black strong bristles is arranged on either side of the latero-apical part of the fourth sternite reminding one of

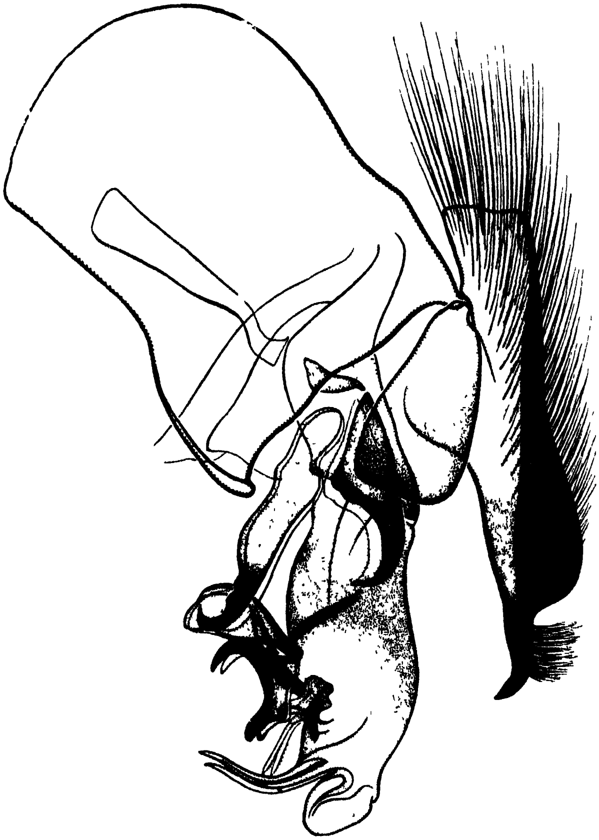


Fig. 1. — Male hypopygium of *Sarcophaga Tewfiki* nov. spec.

the patch of dense hairs soft of the fourth sternite seen in Oriental and Australian Sarcophagidae and rendering this species extremely easy to pick among the Egyptian *Sarcophaga* as it is the sole species known till now to possess such a peculiar fourth sternite. Lamellae of fifth sternite orange in colour and with few stiff bristles attached apically. Seventh tergum bright orange with some grey dusting posteriorly but without a marginal row of

bristles apically. Tenth tergum entirely orange and is about half as long as the seventh tergite. It is also markedly domed in appearance.

Male Hypopygium : Anal cerci very dark brown to black in colour with a marked hump on the ventro-median margin beyond which the plate is much narrowed and the margins run evenly to a curved and pointed apex. Immediately proximal to the apex and below the above mentioned hump on the same margin is a characteristic tuft of soft hairs. This is again the only known Egyptian species to possess such a tuft of hairs on the anal cercus. This character together with the patch of long bristles on either side of the hind margin of the fourth sternite form a very reliable and easy way of spotting this fly. *Distal segment of ninth coxite* orange colour and triangular with the apex between the tenth tergite and the anal cercus covered with long black hairs. *Parameres* anterior pair longer than the posterior, apical ends curved upwards and flat not rolled. The posterior pair is not much hooked but is more darkly chitinised than the anterior pair and possesses two bristles near its base, the proximal of which is more than double the length of the distal.

Phallosome : Proximal part measured from the base of the posterior paramere to the joint is half as long as the distal. End piece is more swollen and darkly chitinised basally and carries a complicated group of bilaterally symmetrical gadgets. Distal part of the end-piece very pale and more or less blunty pointed. The gadgets carried on the dorsal surface of the proximal part of the end piece are best understood by reference to the drawing. They are arranged as follows from above downwards :

(1) A markedly convex broad plate below which (2) a pair of very dark hook-like structures and below these (3) one pair of short narrow toothed rods (4) and just above the terminal part of the end piece are two elongated apodemes and most distally the lobe-like blunt apical part.

Locality : Three males were found in the collection, all carrying the label of Wadi Edeib, 26.II-7.III.1938. The types are in the collection of the Entomology Department, Faculty of Science, Cairo. This species is named after its collector Mohamed Tewfik effendi, Technical Assistant of the Entomology Department, Faculty of Science, Cairo, in recognition of his valuable services.

Sarcophaga Kadeisi Salem

Described by the author in 1938 from Ein Kadeis, Sinai. One male in the collection of Prof. H. C. Efflatoun Bey was found. Since in the first description of the male hypopygium the terminal parts of the phallosome were slightly damaged a new drawing and a description of the hypopygium from an intact specimen seemed preferable.

Male Hypopygium : Anal cerci moderately hairy at base. Apical part far less so. Anterior margin with a pre-apical emargination. Posterior margin evenly curved. Distal segment of ninth coxite more or less rectangular. plate with a nipple-like process at the lower dorsal angle where it touches the cercus.

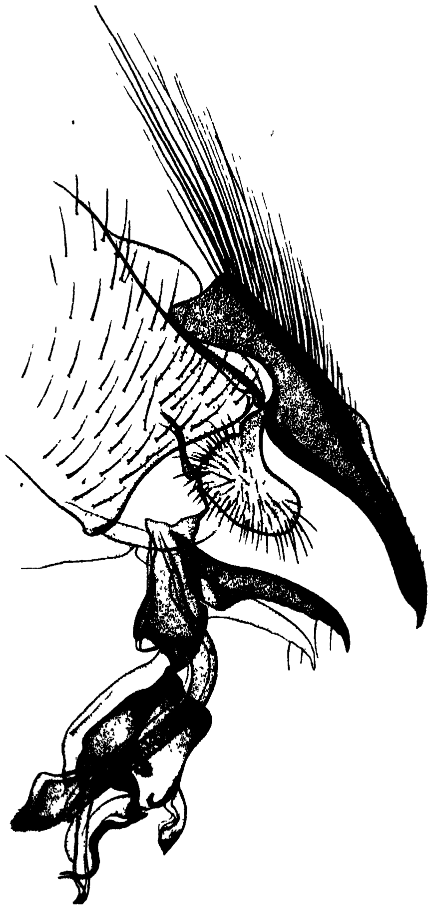


Fig. 2. — Male hypopygium of *Sarcophaga Kadeisi* Salem.

Parameres : Anterior pair longer than the posterior. Anterior pair slightly expanded plate-like but the posterior is hooked apically and is provided with two short bristles on the anterior margin pre-apically. *Phallosome* with its basal segment nearly of the same length as the apical segment. It is well chitinised dorsally and ventrally and not much so laterally. The end piece carries the following parts dorso-ventrally and from above downwards :

(1) A single median oval lobe with very dark chitinisation on its lower

surface and with characteristic teeth on the dorsal half of its lower margin.

(2) One pair of long narrow apodemes taking origin from the proximal lateral parts of the bilobed end piece of the phallosome.

(3) Projecting from the dorsal cavity of the end piece below the first lobe is a pair of lightly chitinised bars. These run downwards between the apodemes already mentioned; their broad apices then curve gently upwards towards the lobe.

(4) The ventral part of the end piece is slightly bilobed and well chitinised and does not reach to the level of the apodemes nor the bars already referred to.

One male carrying the label of Wadi Edeib, 26.II-7.III.1938 and belonging to the collection of the Entomology Department, Faculty of Science, Cairo.

Séance du 14 Février 1940

Présidence de Monsieur le Professeur H. C. EFFLATOUN Bey,
Vice-Président

Further observations on *Anopheles rupicolus* Lewis, *Culex arbieeni* Salem, and *Culex theileri* Theobald

[Diptera: Culicidae]

(with 6 Text-Figures)

by HASSAN HILMY SALEM, M.B., M.Sc.,
Ph. D. (Fouad I[st] University), D.T.M. and H. (England),
of the
Parasitology Department, Faculty of Medicine, Cairo.

In 1938, in a description of the Mosquito Fauna of Sinai Peninsula (Egyptian University Publication No. 16) two new species of Culicidae were described by the author. The first was a species of *Anopheles* which was named *aegypti* and the second was a species of *Culex* named *arbieeni*. Immediately after publication, Dr. F. Edwards of the British Museum informed the writer that the new *Anopheles* had been just described by Lewis from Gabel Moya in the Blue Nile Province (Anglo Egyptian Sudan) under the name of *rupicolus*. On referring to Lewis's description, it was evident that his species *rupicolus* and *aegypti* Salem were one and the same. Therefore *aegypti* Salem falls synonymous with *rupicolus* Lewis which remains the valid name.

Anopheles rupicolus Lewis

Lewis did not describe the egg stage of this mosquito but the author described and fully illustrated the egg as well as the other stages of this

species. Few and minor differences do exist between the Egyptian material and the description of Lewis but in the opinion of the writer these do not merit a new specific name for the mosquito.

A pale median tuft of scales on the anterior promontory of the mesonotum was mentioned by Lewis in his description. Such a tuft is entirely absent from the Egyptian material. In our material the mesonotum is shiny and is of pale brown colour and only sparsely covered with long bristles. In our description of the hypopygium it was mentioned that the phallosome possessed three leaflets on either side. On re-examination and dissection of new material it was found to possess five leaflets and thus conforms with the description of Lewis.

Culex arbieeni Salem

(Figs 1-5)

Dr. F. Edwards suggested too that the second mosquito described in the paper as *Culex arbieeni* is very similar to *Culex apicalis*. I have not been able to examine the latter species but from Martini's description of *Culex apicalis* Adams and its variety *judaicus* Edwards, my conclusion is that though the two species may possess similar abdominal markings in the adult stage, yet there should be no doubt whatsoever about the validity of *arbieeni* Salem. Recently the author had the chance of again visiting Sinai and collecting some larvae and breeding the adults. The findings from a very careful study of the successive larval and pupal pelts as well as the hatched adults show that *arbieeni* Salem is a distinct species in several respects :

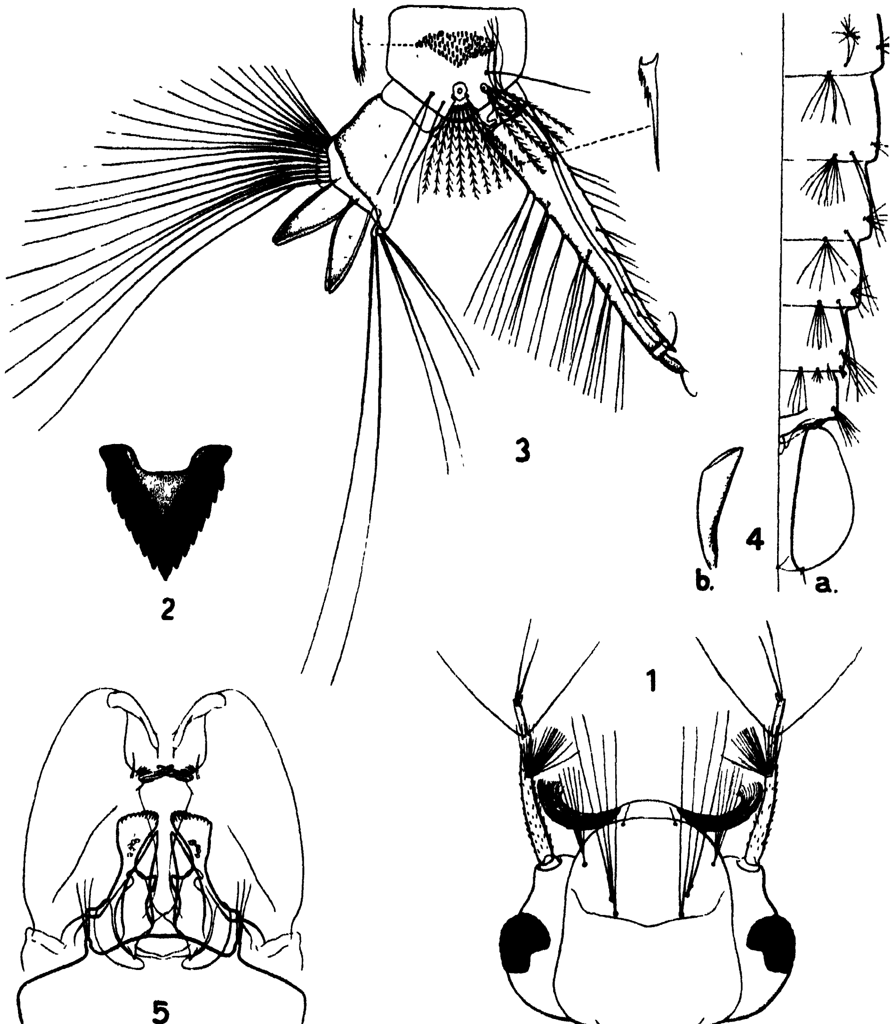
(1) In the larval stage *Culex arbieeni* Salem is very different from any other species of *Culex* hitherto described. Its head and respiratory syphon are re-illustrated for the sake of clarity. Especially peculiar are :

(a) The point of insertion of the antennal hair tuft, being situated slightly on the proximal side of the basal half of the antenna. The sub-terminal setae and their length and position.

(b) The arrangement of the hair tufts on the respiratory syphon is extremely peculiar to this larva and really is its most characteristic feature. The presence and arrangement of the sub-terminal hair tufts together with several laterals and some dorsals are outstanding characters. Also the abnormal length of the four terminal syphonal hairs.

(2) In the adult stage *Culex arbieeni* Salem is also a very distinct species. The female has the peculiar feature that its maxillary palp are longer than usual being about one-fourth of the length of the proboscis.

(3) In the male, the hypopygium has well-marked features that render its separation from other species quite simple. Since in the first account that appeared about this mosquito the description of the pupa and male hypopygium were made from slightly squashed specimens, and since new material



Culex arbieeni Salem.

Fig. 1. — Head of fourth stage larva showing the frontal hairs, antennae with the sub-terminal and terminal setae.

Fig. 2. — Mentum.

Fig. 3. — Last abdominal segments of fourth stage larva, the eighth segment with the comb, the syphon with its peculiar hair tufts and the anal segment.

Fig. 4. — Pupa: a. Abdominal segments showing the arrangement of the bristles; b. Respiratory trumpet of same.

Fig. 5. — Adult: Male hypopygium showing the different parts and their arrangement.

is now available certain amendments to the original description were found necessary.

The Pupa

Seta A on the fourth segment with four very delicate branches but on the fifth and sixth segments this seta has 4 or 5 delicate branches. On the seventh segment it has five to six well developed branches each nearly three-quarters as long as the segment. On the eighth segment it has six to seven branches, similar to those of the proceeding segment only slightly shorter.

Seta B on IV with two long feathered branches slightly longer than the segment, on V and VI again it has also two branches much longer than the segment. On VII with two very delicate short branches.

Seta C on IV, V, VI and VII with nine, six, six and four delicate branches nearly three-quarters of the length of the segment.

Paddle has the ratio of its length to breadth 4:3. Trumpets with a radio of 4:1 branch being taken at the apical opening of the trumpets. Paddle nearly one and a quarter times as long as the trumpets.

Two paddle hairs one long and the other short are present.

The Male Hypopygium

Side-piece densely hairy on the dorsal surface. No scales are present. It is nearly one and half times as long as broad, breadth being taken at the base of the side-piece. Sub-apical lobe of side-piece of moderate development. It carries one pair of long strongly hooked finger-like processes. No plate of any type exists on this lobe but distal to the attachment of the former hooked processes there are two pairs of fine pointed bristles on the lobe. Clapser nearly half as long as the side-piece. Its sub-terminal digit-like appendage is well developed and measures nearly one quarter of the length of the clasper. Tenth sternite without a basal arm. It carries terminally a crown of few short blunt thorn-like spines averaging about six in number and other shorter and sharper spines. The ventro-lateral plates of the anal segment has a group of seven sensory pits with sensory hairs. The lower part of the median margin of the ventro-lateral plate of the anal segment is not straight but is deeply emarginate ending in a strong sharp tooth on level with the apex of the phallosome (see Fig. 5). The dorsal plate of the anal segment is well represented by an apically blunt elongate plate. Phallosome is very simple being made up of only one single short broad-like plate with its apex narrow and strongly curved outwards, terminating at the level of the tooth at the bottom of the concave margin of the ventro-lateral plate of the anal segment. Parameral plates very small, oval in shape and articulating to the apices of the basal plates as usual. Lobes of ninth tergum small and nipple-like and each with three long fine hairs.

The characteristic features of this hypopygium may be summarised as follows :

(1) Lobe of side-piece without plates and only with two strongly hooked finger-like processes.

(2) The deep emargination and the prominent tooth-like projection on the median margin of the ventro-lateral plate of the anal sclerite.

(3) The simplicity of construction of the phallosome and the small size of the parameral plates.

The types are in the collection of the Parasitology Department and the adults as well as the larvae were collected from a water reservoir in Wadi El Arbieen near the Monastry of Saint Catherine in the Sinai.

An uncommon arrangement of the parts of the Male Hypopygium in Culex theileri Theobald

In two male specimens of *Culex theileri* Theobald from Kharga Oasis the division of the phallosome were in an uncommon position being more or less spread outwards. The simple and bluntly pointed inner division is

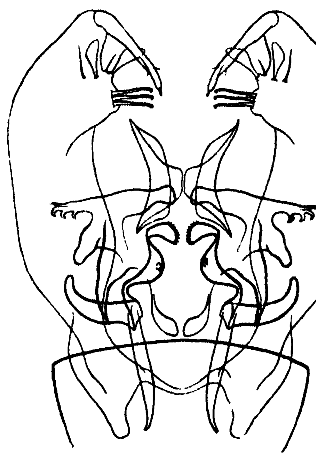


Fig. 6. — *Culex theileri* Theobald : Functioning position.

directed here outwards and downwards directly in front of the curved handle of the basal arm of the ventro-lateral plate of the anal segment, instead of being directed downwards and outwards the crown of the thorn-like spines on the apex of this plate (see Fig. 6). The second division of the phallosome with its characteristic four teeth is here curved outwards and upwards towards the basal arms of the tenth sternite. The parameres are horizontally displaced instead of their usual vertical position in relation to the basal plates.

It seems that the present position of the parameres is more or less responsible for the general displacement of the parts of the phallosome.

Edwards directed the attention of displacement in a specimen of *Culex pallidocephalus* in 1914. He said that "Normally the small basal parts of the hypopygium are in the relative position in which they are shown in this hypopygium (unci, harpagones and harpes), but sometimes (perhaps after use) they take up another position relatively to one another, in which the unci are folded outwards and the harpagones pushed out so that they occupy a position at right angles to the normal one." The figure of *Culex pallidocephalus* (Bull. Ent. Res., May 1913) represents these parts in this position; a specimen in which they are thus placed (and the dislocation may occur in any species of *Culex*) at first sight appears to possess a very different structure from one in which the position is normal. Martini has published figures for *Culex modestus* and *Culex laticinctus* in a similar condition which he names "Funktion stellung." Such a displacement of parts is not common in mosquitoes and at first sight is apt to mislead those studying these complicated structures and for this reason an illustration of the male hypopygium in this uncommon position is certainly not superfluous.

There are two other points in which these mosquitoes differed from the ordinary form of *Culex theileri* Theobald :

(1) The possession of two lower meso-epimeral bristles (Kirkpatrick does not mention the number of lower meso-epimerals). In the Egyptian material I examined one bristle was always present and in a Chinese specimen received from the late Dr. A. Evens of the Liverpool School of Tropical Medicine two bristles were found.

(2) The pale yellow central bands of scales reach to the apex segments of the abdominal early as from the second segment and the pale scales tend to cover practically the whole segment save for small patches on either side of the middle band. The apical part of these bands touches the posterior margin of the abdominal segments and they tend to spread also to the apex of the segments.

Etude préliminaire des *Leptolarra* Cam. (=*Notogonia* Costa) de la faune égyptienne

[Hymenoptera : Sphecidae]

par Jacques de Beaumont

La question du nom générique à adopter pour ces insectes n'est pas complètement résolue. Alors que Richards admet *Leptolarra* Cam., Pate voudrait qu'on les nomme *Motes* Kohl. A mon avis, les espèces devraient former un simple sous-genre de *Liris* F.

D'autre part, la synonymie de certaines espèces étant très embrouillée, les noms ci-dessous ne sont, peut-être, que provisoires.

Leptolarra memnonia Sm.

♂. — Fémurs postérieurs fortement échancrés; 5e sternite avec une touffe de poils de chaque côté. Des bandes de pruinosité sur les 3 premiers tergites.

♀. — Aire pygidiale mate et velue; bandes de pruinosité comme chez le ♂.

Leptolarra aff. memnonia Sm.

Diffère de la précédente par la présence de pruinosité sur les 4 premiers tergites. Le ♂ n'a pas de touffes de poils au 5e sternite.

Leptolarra aff. solstitialis Sm.

Bien reconnaissable à ses pattes en partie rouges. Le ♂ a les fémurs peu échancrés et de longs poils au 4e sternite.

Leptolarra agilis Sm. (= pompiliformis auct.)

Aire pygidiale de la ♀ brillante. Fémurs postérieurs du ♂ simples.

Certaines ♀♀, à aire pygidiale plus large et moins ponctuée, sont probablement des *opalipennis* Kohl.

Leptolarra nigrita Lep.

Facilement identifiable à sa grande taille et à ses ailes enfumées. Le ♂ est caractérisé par une gouttière longitudinale à la face inférieure de ses fémurs postérieurs.

Leptolarra pharaonum Kohl

N'est probablement qu'une variété de petite taille et à ailes peu enfumées de *Leptolarra nigrita* Lep.

Leptolarra praetermissa Richards

Thorax plus nettement ponctué que chez les espèces précédentes. Segment médiaire à sculpture plus forte. Aire pygidiale de la ♀ mate et velue. Fémurs postérieurs du ♂ simples. Ponctuation des mésopleures très dense dans les deux sexes. Articles 3-13 des antennes du ♂ subégaux, longs.

Leptolarra nigricans Walk.

Se distingue de *Leptolarra praetermissa* Rich. par la ponctuation des mésopleures plus espacée et par la structure des antennes du ♂ à articles 3-5 assez courts, articles 6-13 longs.

Leptolarra ? miscophoïdes Arnold

Petite espèce, caractérisée par une bande foncée en travers des ailes.

Assemblée Générale Ordinaire du 28 Février 1940

Présidence de Monsieur le Professeur H. C. EFFLATOUN Bey, *Vice-Président*

Rapport du Secrétaire Général (exercice 1939) :

Messieurs,

En dépit des événements actuels et des nombreuses difficultés que rencontrent un peu partout, en ces temps troublés, les diverses institutions scientifiques, la Société Fouad I^er d'Entomologie s'est efforcée de maintenir son activité des années précédentes. Un aperçu de la situation morale et financière de l'Exercice vous est donné par le Rapport qui vous est soumis aujourd'hui.

Tout d'abord, se conformant au vœu que vous avez formulé au cours de l'Assemblée Générale Ordinaire du 8 Mars 1939, votre Conseil a entrepris de nombreuses démarches relatives à la Présidence de la Société. Si aucun résultat n'a pu encore être obtenu, il faut l'attribuer aux préoccupations actuelles des autorités compétentes.

Le fait dominant de l'Exercice est la forte recrudescence des visiteurs. Fonctionnaires et universitaires, techniciens ou étudiants, ont régulièrement consulté notre bibilothèque et nos collections. Il leur a été fourni tous les renseignements désirés et de nombreuses déterminations d'insectes.

Notre Bulletin pour l'année 1938 a été distribué au mois de Mars. Cette publication de plus de 400 pages, illustrée de très nombreuses figures et de deux planches en couleurs, contient vingt études originales d'un niveau scientifique élevé.

Une importante collection de Lychens d'Egypte, recueillis et déterminés par feu E. Sickenberger, est venue enrichir notre herbier.

L'enregistrement des ouvrages, périodiques ou brochures en Bibliothèque atteint le nombre de 12729, contre 11714 en 1938, en augmentation de 1015 unités.

Des démarches entreprises pour la réduction de l'impôt foncier l'ont porté de L.E. 57.600 à L.E. 36 annuellement.

Le nombre de nos membres, de toutes catégories, est de 324, en légère augmentation malgré divers démissions et décès.

De nombreuses conférences ont été données dans notre local par diverses institutions scientifiques.

Nous adressons à Son Excellence le Ministre de l'Agriculture nos remerciements bien chaleureux pour la subvention annuelle qu'Elle nous a fait verser par son Ministère.

Votre Trésorier a établi le Bilan des Comptes de l'Exercice et vos Censeurs l'ont vérifié et approuvé.

Aux termes de l'article 13 des statuts le Conseil est annuellement renouvelé par tiers. Les membres sortants cette année sont les suivants : Son Excellence Fouad Abaza Pacha, Messieurs le Dr. H. Priesner, Richard Wilkinson et Abdel Megid el Mistikawy. Ils sont rééligibles.

Vous aurez également à élire deux Censeurs.

Nous terminons ce Rapport en dédiant nos respectueuses pensées à notre Bien-Aimé Souverain, Sa Majesté le Roi Farouk 1er et Lui exprimons nos sentiments de profonde dévotion et nos vœux les plus fervents.

Signé : A. Alfieri

Rapport du Trésorier :

Situation au 31 Décembre 1939

Doit	L.E.	MM.	Avoir	L.E.	MM.
Compte Bâtiment (pour mémoire)	1	000	Compte Réserve Générale	15627	382
» Mobilier » »	1	000	» Subvention du Gouvernement.............	447	300
» Bibliothèque » »	1	000	» Coupons.............	703	807
» Collections » »	1	000	» Intérêts..............	40	552
» Laboratoire » »	1	000	» Cotisations.....	64	151
» Portefeuille	13535	913	» Diplômes	0	400
» National Bank of Egypt.	1972	878	» Vente Publications	8	000
» Cie du Gaz	4	629			
» Appointements........	819	000			
» Publications..........	286	702			
» Frais Généraux et Entretien	180	601			
» Impôts et Assurances..	86	869			
	16891	592		16891	592

Inventaire

Actif	L.E.	MM.	Passif	L.E.	MM.
Bâtiment (pour mémoire)	1	000	Réserve Générale.......... .	15518	420
Mobilier » »	1	000			
Bibliothèque » »	1	000			
Collections » »	1	000			
Laboratoire » »	1	000			
Portefeuille...............	13535	913			
National Bank of Egypt.......	1972	878			
Cie du Gaz..................	4	629			
	15518	420		15518	420

Le Portefeuille Titres en dépôt à la National Bank of Egypt se décompose comme suit :

145 Obligations Héliopolis 5 %.
9020 £ Dette Unifiée Egyptienne 4 %.
6700 £ Dette Privilégiée Egyptienne 3 ½ %.

Signé : R. Wilkinson

Rapport des Censeurs :

En exécution du mandat que vous avez bien voulu nous confier, nous avons l'honneur de porter à votre connaissance que nous avons vérifié les Comptes de la Société Fouad Ier d'Entomologie pour l'année finissant le 31 Décembre 1939 avec les régistres et documents y relatifs.

Nous certifions que le Bilan reflète d'une façon exacte et sincère la situation de la Société telle qu'elle ressort des régistres et des explications qui nous ont été données.

Signé : Dr. A. Azadian et E. Kaourk

Prévisions Budgétaires pour l'année 1940 :

Recettes

	L.E.	MM
Subvention du Gouvernement Egyptien	450	000
Coupons	703	000
Cotisations	60	000
Intérêts	40	000
Vente Publications	5	000
	1258	000

Dépenses

	L.E.	MM.
Publications	200	000
Appointements	819	000
Frais Généraux	150	000
Impôts	36	000
Assurances	26	000
Abonnements Bibliothèque	5	000
Entretien	15	000
Imprévus	7	000
	1258	000

Signé : R. Wilkinson

Décisions

1° L'Assemblée Générale Ordinaire approuve les Rapports du Secrétaire Général, du Trésorier et des Censeurs et donne décharge au Conseil de sa gestion pour l'exercice 1939.

2° Sur la proposition de Monsieur le Professeur H. C. Efflatoun Bey, l'Assemblée remercie le Secrétaire Général et le Trésorier des efforts qu'ils ont déployés au cours de l'exercice en vue de la bonne marche de la Société.

Elections :

Messieurs le Professeur Docteur H. PRIESNER, S.E. FOUAD ABAZA Pacha, RICHARD WILKINSON et ABDEL MEGID EL MISTIKAWY, membres du Conseil sortants, sont réélus.

Monsieur MOHAMED SOLIMAN EL ZOHEIRI est élu en remplacement du feu SAID BAHGAT Bey.

Messieurs le Docteur A. AZADIAN et E. KAOURK sont réélus aux fonctions de Censeurs des Comptes de la Société.

Séance du 27 Mars 1940

Présidence de Monsieur le Professeur MAHMOUD TEWFIK HIFNAOUI Bey,
Président.

Présidence de la Société :

Par Décret Royal en date du 14 Février 1940 et publié dans le Journal Officiel du Gouvernement Egyptien, 67ème année, N° 18, du Lundi 19 Février 1940, Monsieur le Professeur MAHMOUD TEWFIK HIFNAOUI Bey, Ministre de l'Agriculture, est nommé Président de la Société Fouad Ier d'Entomologie.

Réception du nouveau Président :

Allocution de Monsieur le Professeur H. C. EFFLATOUN Bey. Vice-Président :

Monsieur le President,

C'est avec une vive satisfaction que nous avons accueilli le Décret Royal du 14 Février 1940 relatif à votre nomination à la Présidence de la Société Fouad Ier d'Entomologie.

Au nom de Membres du Conseil d'Administration et de tous les membres de la Société, je vous adresse nos félicitations les plus sincères et nos vœux les meilleurs pour une longue et féconde présidence.

Guidée par vos conseils avisés et votre profonde expérience, la Société connaîtra, nous en sommes persuadés, un nouvel essor qui lui permettra de poursuivre, sous l'égide de son bien-aimé souverain Sa Majesté le Roi FAROUK Ier, la voie qui lui avait été tracée par son glorieux animateur et grand bienfaiteur, le très regretté FOUAD Ier.

Allocution de Monsieur le Professeur MAHMOUD TEWFIK HIFNAOUI Bey, Ministre de l'Agriculture et Président de la Société Fouad Ier d'Entomologie :

Monsieur le Vice-Président, Messieurs,

Notre bien-aimé souverain, Sa Majesté le Roi FAROUK Ier, a daigné me nommer Président de la Société Fouad Ier d'Entomologie.

Cette sollicitude royale m'honore et couronne vos nombreuses démarches relatives à la Présidence de la Société.

Je suis particulièrement heureux de la confiance que vous avez placée

en moi et je vous en remercie bien sincèrement. Vos félicitations et vos bons souhaits, et ceux qui m'ont été adressés par la plupart des membres de la Société m'ont également profondément touché. Je saisis cette occasion pour vous en exprimer tous mes remerciements.

Soyez convaincus que je m'emploierais de mon mieux aux intérêts et au développement de la Société. Comme l'ont fait mes prédécesseurs, je m'acquitterais de cette tâche en m'appuyant sur votre précieuse collaboration.

Nous sommes tous fiers du grand prestige dont jouit la Société de par le monde et nous travaillerons ensemble pour l'épanouissement sous le règne de Sa Majesté le Roi FAROUK I^er^, d'une si belle institution scientifique, œuvre du feu Roi FOUAD I^er^.

L'allocution présidentielle est chaleureusement applaudie.

Dons à la Bibliothèque :

La Société a reçu les ouvrages suivants :

1° De Monsieur HENRI GADEAU DE KERVILLE, de Rouen (France) : un exemplaire de son « Voyage Zoologique d'Henri Gadeau de Kerville en Asie-Mineure (Avril-Mai 1912), Tome I, première partie, publié à Paris en 1939.

2° De Monsieur F. SILVESTRI, de Portici (Naples, Italie) : son remarquable travail « Compendio di Entomologia Applicata (Agraria-Forestale-Medica-Veterinaria), Parte Speciale, Vol. I (première et deuxième parties [2 volumes]), publié à Portici, 1934-1939.

Le Conseil remercie les généreux donateurs.

Nomination d'un Membre Honoraire :

Sur la proposition de Messieurs le Professeur Docteur H. PRIESNER et A. ALFIERI, Monsieur le Docteur F. SILVESTRI, de Portici (Naples, Italie), est nommé Membre Honoraire de la Société.

Admission de Membres :

Monsieur le Professeur MAHMOUD TEWFIK HIFNAOUI Bey, Ministre de l'Agriculture et Président de la Société Fouad I^er^ d'Entomologie est nommé membre titulaire de la Société.

Sont également admis à faire partie de la Société en qualité de membres titulaires :

Messieurs AHMED HOUSNY IBRAHIM AHMED NOUR EL DIN et MICHEL ZAKI, de la Section d'Entomologie du Ministère de l'Agriculture, présentés par Monsieur le Professeur Docteur H. PRIESNER et MOHAMED SOLIMAN EL ZOHEIRY; Monsieur MOHAMED FARGHAL ALY, étudiant à la Faculté d'Agriculture, Université Fouad I^er^, présenté par Messieurs le Docteur HAMED SELEEM SOLIMAN et MOHAMED SOLIMAN EL ZOHEIRY.

Echanges :

Est approuvé l'échange des publications avec les Institutions suivantes :

1° MUSEO LIBICO DI STORIA NATURALE, Piazza Santa Maria degli Angeli, Tripoli d'Africa, Libye (*Annali*).

2° Ufficio Idrobiologia e Pesca, Direzione Superiore Affari Colonizazione e Lavoro, Governo Generale dell'Africa Orientale Italiana, Addis Abeba Abyssinie (*Bulletino*).

Elections :

Les votes relatifs à la constitution du Bureau du Conseil et du Comité Scientifique pour l'exercice 1940 donnent les résultats ci-dessous :

Sont élus : Monsieur le Professeur H. C. EFFLATOUN Bey et Monsieur le Professeur Docteur H. PRIESNER, *Vice-Présidents;* Monsieur ANASTASE ALFIERI, *Secrétaire Général;* Monsieur RICHARD WILKINSON, *Trésorier.*

Sont élus membres du Comité Scientifique : Messieurs le Professeur H. C. EFFLATOUN Bey, le Professeur Docteur H. PRIESNER, le Docteur KAMEL MANSOUR, le Docteur MOHAMED SHAFIK, le Docteur HAMED SELEEM SOLIMAN, le Docteur SAADALLAH MOHAMED MADWAR, MOHAMED SOLIMAN EL ZOHEIRY et ANASTASE ALFIERI.

Ammoplanopterus nov. gen. *sinaiticus* nov. spec.

[Hymenoptera : Sphecidae-Pemphredoninae]

(con 8 Figure)

per il Dott. ALBERTO MOCHI

Un piccolo sfegide catturato all'Wadi Umm Mitla nel Sinai il 21 Marzo 1937, appartenente al sesso maschile, lungo 2,1 mm., presenta caratteri tali da render necessario di creare un genere nuovo.

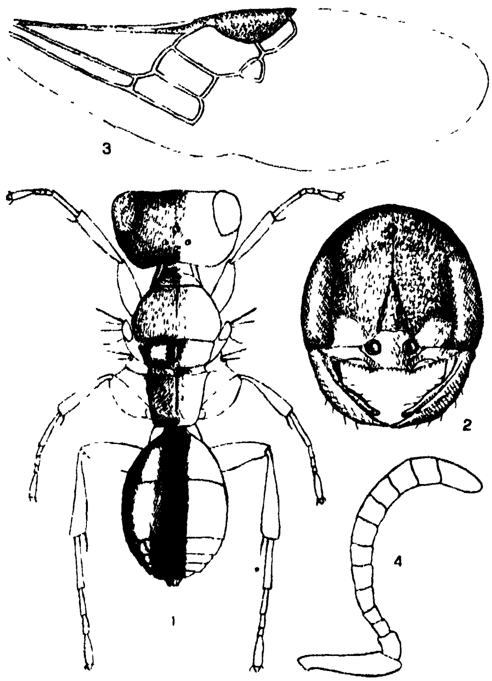
L'aspetto generale e la maggior parte dei caratteri son quelli del genere *Ammoplanus*, e cioè, testa con diametro trasverso maggiore di quello del torace, occipite e tempie sviluppatissimi, occhi che raggiungono le basi delle mandibole, clipeo bassissimo, antenne inserite subito a disopra del suo margine superiore, di 13 articoli (♂), con lo scapo molto lungo. Collare stretto, più basso del dorsulo, mesonoto e postscutello corti e larghi, segmento mediano lungo, troncato ad angolo retto indietro, senza area cordata. Addome ovalare, non peziolato, con 7 segmenti visibili, senza area pigidiale (♂). Zampe sottili, poco spinose, senza caratteri speciali. Nonostante queste coincidenze, il mio esemplare non può esser classificato nel genere *Ammoplanus* a causa della nervatura alare. Lo stigma è grosso come in questo genere; la cellula radiale però ha una forma speciale. La nervatura radiale, inflettendosi medialmente prima di raggiungere il margine dell'ala, viene ad incontrare il bordo laterale dello stigma e chiude così la cellula in modo che la parte alta dello stigma stesso viene a trovarsi fuori della regione delle nervature. Le cellule cubitali sono due e ricordano quelle dei *Miscophus* : la prima molto grande, simile a quella unica caratteristica del genere *Ammoplanus*, la seconda piccolissima, triangolare, appendicolata, sorgente verso la metà della lunghezza della nervatura che chiude lateralmente la prima, talchè si ha l'impressione che la porzione della nervatura cubitale che la chiude in basso si inserisca sulla prima ricorrente. Il resto della nervatura alare è come in *Ammoplanus* alle ali anteriori; per quanto riguarda le posteriori mi è impossibile un giudizio sicuro, perchè sono mal conservate nel mio esemplare : quello che ne rimane (parte basale) non differisce però dalla porzione corrispondente del genere *Ammoplanus*.

L'esemplare che ho sotto gli occhi presenta i seguenti caratteri specifici :

Colore del corpo nero lucente. Sono gialli il clipeo, una macchia al disopra

di ciascuna delle sue parti laterali estendentesi fino al margine oculare, le mandibole, il labbro e i palpi (labiali di 4, mascellari di 6 articoli), l'estremità dei femori, le tibie e i tarsi (le tibie e gli ultimi articoli tarsali intermedi e posteriori oscurati in bruno-ocra). Antenne giallo ocra. Scagliette brunastre. Stigma bruno-scuro unicolore, nervature alari giallo-ocra chiaro.

Parte media del clipeo con un piccolo dente ai lati del margine libero. Al disopra del clipeo, al mezzo, un leggero rilievo conico. L'ocello anteriore è



Ammoplanopterus nov. gen. *sinaiticus* nov. spec.

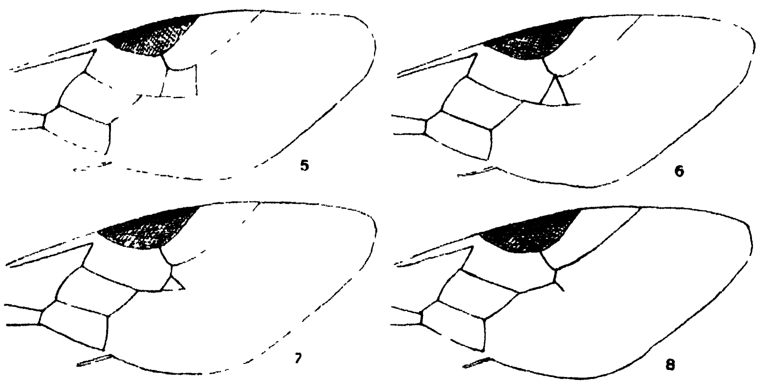
Fig. 1 : Aspetto generale e scultura — Fig 2 : Testa vista dal davanti. — Fig. 3 : Ala anteriore. — Fig. 4 : Antenna.

quasi sulla linea che congiunge i margini posteriori degli occhi, i posteriori sono assai più indietro, molto più vicini fra loro che alla linea che prolungherebbe idealmente il margine interno dell'occhio. Tutta la testa è lucente, microreticolata, senza macroscultura. Le mandibole sono bidentate all'apice, ondulate sul margine mediale. Le antenne hanno lo scapo un pò più lungo dei primi cinque articoli del funicolo insieme; di questi il primo (pedicello) è quasi due volte maggiore del secondo, gli altri aumentano gradualmente di lunghezza, l'ultimo è il più lungo di tutti, raggiungendo la lunghezza dei primi tre insieme. Le antenne sono nettamente clavate, la lunghezza del

dodicesimo articolo del funicolo al suo margine prossimale è una volta e mezzo quella del secondo al margine distale.

Il collare è trasversalmente macrostriato, il dorsulo microstriato longitudinalmente con le strie interrotte, leggermente solcato al mezzo nel senso longitudinale anteriormente, con pochi piccoli punti sparsi. Lo scutello, microstriato sui lati, presenta al mezzo un solco che lo divide in due; il postscutello è micropuntato sui lati, liscio al mezzo. Il segmento mediano porta una macrostriatura-reticolazione obliquo-trasversa e un solco mediano longitudinale netto. Le scagliette sono di conformazione ordinaria; le zampe non presentano speciali caratteri; le unghie sono piccole, semplici, i pulvilli mediocremente sviluppati.

L'addome è tutto liscio, lucentissimo, con gli ultimi tergiti pelosi sui lati, il pigidio troncato (♂). Dal lato ventrale i margini distali del terzo, quarto e quinto sternite sono muniti di peli assai lunghi che, verso il mezzo, si riuniscono a formare ad ogni lato della linea mediana pennelli appuntiti agglutinati, ben visibili di profilo.



Figg. 5-8. — Vedute teoriche nel passagio dai generi *Stigmus* o *Spilomena* al genere *Ammoplanus* per riduzione della seconda cellula cubitale.

Le piccole specie appartenenti al genere *Ammoplanus* e affini sono state studiate soltanto negli ultimi anni. Il Gussakovskij (1) ha scisso il genere in due sottogeneri, *Ammoplanus* s.str. con la cellula radiale chiusa, *Ammoplanellus* con la detta cellula aperta; ha inoltre descritto un genere nuovo, *Ammoplanops* che, pur presentando la nervatura alare come nel genere *Ammoplanus*, per altri caratteri si avvicina ai *Diodontus*. Il genere *Ammoplanopterus* presenta uno speciale interesse soprattuto perchè verifica vedute teoriche

(1) Gussakovskij: Revision der Gattung *Ammoplanus* Giraud und einiger verwandten Sphegidengattungen (Bolet. de la Soc. espan. de historia natural, 1931, pag. 437).

che il Kohl aveva emesse fin dal 1896 ([2]). Questo autore ha pensato che il passaggio dal genere *Stigmus* o *Spilomena* con due cellule cubitali al genere *Ammoplanus* con una sola dovesse essersi effettuato per fusione della prima con la seconda nervatura ricorrente, dapprima parziale (seconda cellula cubitale triangolare o appendicolata), poi totale (seconda cellula cubitale scomparsa). Basta confrontare il disegno della nervatura alare di *Ammoplanopterus* con gli schemi del Kohl (Figg. 5-8) per osservare la coincidenza della struttura osservata con quella teoricamente dedotta.

([2]) Kohl: Die Gattungen der Sphegiden (Ann. des k.k. naturhistor. Hofmus. Wien, XI, 1896, pag. 272).

Zwei neue Goldwespen aus Aegypten

[Hymenoptera: Chrysididae]

von Dr. STEPHAN ZIMMERMANN, Wien

In einer mir von Herrn A. Mochi, Cairo, zur Determination übersandten Kollektion aegyptischer Chrysididen fanden sich zwei neue Arten, die im Folgendem beschrieben werden.

Notozus discedens nov. spec.

Kopf : Genae überaus kurz, Voldergesicht sehr breit und fast glatt. Cavitas facialis mässig vertieft, glatt, in ihrer Mitte eine seichte Längsrinne, oben ohne Abschlussleiste. Vor den Ocellen beginnt eine spärliche grobe Punktierung, die am Hinterkopf etwas dichter wird; die Zwischenräume zwischen den Punkten sind vollständig glatt.

Thorax : Vorderecken des Pronotums verrundet. Die Oberfläche des Pronotums ist im vorderen Drittel fast glatt, etwas vor der Mitte liegt eine Reihe grober, regelmässiger, dahinter schwächere, unregelmässigere Punkte; die glatten Zwischenräume sind wie poliert. Mesonotum und Scutellum fast glatt, mit spärlichen gröberen Punkten. Metanotum-Lamelle bis zur Hälfte leicht konvergierend, knapp hinter der Mitte am schmälsten, hinter der Mitte unter geringer Verbreiterung gleichmässig verrundet; ihre Oberseite dicht und grob punktiert.

Abdomen : Gestreckt herzförmig. 1. Segment sehr kurz, an der Basis eingedrückt, fast glatt, nur an den Vorderecken mit spärlichen gröberen Punkten besetzt. 2. Segment vorne in der Mitte fast glatt, gegen die Seiten zu mit erst schwächeren, sodann gröberen Punkten; an den Seiten- und Hinterecken des Segmentes spärlichst weissliche Behaarung. 3. Segment nach hinten rüsselartig vorgezogen, am Hinterende eine hufeisenförmige Anhangplatte. Die Seitenränder des 3. Tergites sind je einmal leicht ausgebogen; die Punktierung besteht aus tiefen, grossen Gruben; spärliche, lange, weisse Behaarung.

Klauen der Vorderbeine einfach, ohne Zähne oder Borsten; an der Innenseite der Basis der Klauen ist eine erst bei etwa 60 facher Vergrösserung sichtbare, äussert schwache knötchenartige Verdickung zu erkennen, die keinesfalls als Zähnchen bezeichnet werden kann. Klauen der Hinterbeine ebenso, die auch hier vorhandene äusserst schwache Verdickung an der Innenseite der Basis trägt eine winzige Borste.

Färbung: Fühlerschaft metallisch grün, Fühlergeissel schwarzbraun. Mandibeln und Anhangplatte des 3. Tergits hellbraun, Tarsen und Ende der Tibien gelb, das ganze übrige Tier glänzend smaragdgrün.

Flügel glashell, Flügelgeäder für *Notozus* typisch, jedoch äusserst schwach.

Länge: 3 mm. — 1 Exemplar.

Einige weisse Haare in der Schläfengegend des Kopfes sprechen für das ♂ Geschlecht des Tieres.

Vergleiche mit den beiden bisher aus Afrika beschriebenen *Notozus*-Arten (*Notozus decorsei* Buyss. [Rev. Ent., Caen, Vol. 23, pag. 253, 1904], und *Notozus afer* Mocs. [Monogr. Chrys., pag. 75, 1889]) erübrigen sich im Hinblicke auf die vorstehende Beschreibung. Leider ist die Klauenbildung von *Notozus decorsei* und *Notozus afer* aus den Beschreibungen nicht ersichtlich; von allen europäischen und mediterranen *Notozus*-Formen unterscheidet sich die neue Art jedenfalls durch die zahnlosen, einfach sichelförmigen Klauen. — Aus Aegypten bisher angegeben: *Notozus productus* Dahlb. (Buysson: Mém. Soc. Ent. Egypte, Vol. 1, pag. 12, 1908) und *Notozus spina* var. *rufitarsis* Tournier (Trautmann: Bull. Soc. Roy. Ent. Egypte, pag. 90, 1926).

Fundort: Abu Rawash, Aegypten, leg. A. Mochi.

Type in Coll. A. Mochi, Cairo.

Hedychridium luteum nov. spec.

Kopf: Genae ganz kurz, beim ♂ immerhin noch als schmale vorspringende Leisten entwickelt, bei den ♀ ein Zwischenraum zwischen dem Unterrande der Augen und der Basis der Mandibeln kaum wahrnehmbar. Vordergesicht ziemlich breit, Cavitas facialis mässig tief, an den Seiten und unten dicht und fein, oben gröber punktiert; diese gröbere Punktierung reicht in spitzförmiger Ausdehnung von der Stirne in die Mitte der Cavitas herunter, eine scharfe Grenze zwischen Cavitas und Stirne ist daher nicht vorhanden. Stirn und Scheitel dicht und grob, Hinterkopf etwas schwächer punktiert.

Thorax: Pronotom-Vorderecken verrundet bis schwach gewinkelt. die Skulptur des Pronotums besteht aus ziemlich gleichmässig groben, dicht nebeneinanderliegenden Punkten. Mesonotum, Scutellum und Metanotum sehr grob und ziemlich dicht, nur der Vorderrand des Mesonotum-Mittelfeldes feiner und dichter punktiert.

Abdomen: Von typischer *Hedychridium*-Gestalt, ziemlich flach und breit. 1. Segment an der Basis tief eingedrückt, gleichmässig dicht und ziemlich grob punktiert, nur die Oberfläche des basalen, eingebuchteten Teiles etwas schwächer punktiert. 2. Segment ebenso gleichmässig und dicht, am Hinterrande etwas gröber punktiert. 3. Segment kurz, die Skulptur wie am Hinterrande des 2. Segmentes. Ein schmaler Endsaum des 3. Segmentes ist bei allen vier Exemplaren etwas hyalin; beim ♂ ist diese hyaline Zone

etwas breiter und weist an der proximalen Grenze eine geschlossene Reihe regelmässiger kleiner Punkte auf, die jedoch nicht der "Punktreihe" der *Chrysis*-Arten entspricht, sondern lediglich das Ende der Oberflächen-Skulptur des 3. Tergites darstellt. Die nicht hyalinen Seitenränder des 3. Tergits sind fein und spärlich hell bewimpert.

Die Klauen tragen in der Mitte einen kleinen, senkrecht abstehenden Zahn.

Färbung : Mandibeln braun mit schwarzer Spitze, Fühler einschliesslich des Schaftes gelbbraun, an der Spitze dunkler, Tarsen und Tibien dunkelgelb, letztere selten mit schwach metallischem Schimmer. Kopf und Thorax dunkelgrün mit Kupferschimmer, der feinpunktierte vordere Randteil des Mesonotums manchmal blau. Abdomen ebenso dunkelgelb wie die Beine, ohne metallischem Schimmer.

Flügel glashell, Geäder stark reduziert, Diskoidal- und Radialzelle eben schwach angedeutet.

Länge : 3-4 mm. — 4 Exemplare (1 ♂ und 3 ♀).

Die neue Art erinnert wegen ihres nicht metallischen, dunkelgelben Abdomens auf den ersten Blick an *Hedychridium roseum* Rossi, steht jedoch zu ihm in keiner näheren Beziehung ; durch diese Färbung des Abdomens unterscheidet sie sich von allen aus Aegypten und Afrika überhaupt bisher bekannten *Hedychridium*-Arten.

Fundort : Umgebung von Cairo (Wadi Hof, Ezbet-el-Nachl, Sakkara, leg. A. Mochi).

Typen in Coll. A. Mochi, Cairo, und Dr. St. Zimmermann Wien.

Séance du 24 Avril 1940

Présidence de Monsieur le Professeur Docteur H. PRIESNER,
Vice-Président

Vorlæufige Mitteilung über zwei Tortriciden als Kulturschædlinge in Unterægypten

[Microlepidoptera : Tortricidae]

(mit 1 Tafel)

von Prof. Dr. H. REBEL (Wien)

Nach Mitteilung der Herren Entomologen A. Alfieri und Prof. Dr. H. Priesner treten in Unterägypten — namentlich in der Provinz Menufia — seit einigen Jahren Tortriciden-Larven als Schädlinge in Weizenfeldern und Flachskulturen auf, die der Gattung *Cnephasia* angehören.

Schon F. C. Willcocks erwähnt in seinem Werk über die Getreideschädlinge in Ägypten (The Insect and related pest of Egypt, etc., Vol. II, 1925, p. 101 and note) unter dem Titel « A note on the causes of white ear in wheat », dass die Weissährigkeit (ausser durch andere Schädlinge) auch durch die Larve eines Wicklers (*Cnephasia*) hervorgerufen werden könne.

Materialsendungen von Imagines ergaben, dass es sich um Formen der in Südeuropa weit verbreiteten *Cnephasia pasivana* Hb. handelt.

Bei den derzeit noch unlösbaren Schwierigkeiten [1], die der taxonomischen Beurteilung mancher Art gruppen innerhalb der Gattung *Cnephasia* entgegenstehen, erscheint es zur vorläufigen Unterscheidung der vorlie-

[1] Ausserordentliche Variabilität der Imagines, Versagen des Genitalapparates zur artlichen Trennung, Polyphagie der Larven, etc. (vgl. Kennel Pal. Tortr., pp. 204-206).

genden Formen sweckdienlich, ihnen nach ihren Nährpflanzen Kennamen zu geben.

So mag die als Larve auf Weizen lebende Form als « *pyrophagana* », jene von Flachs als « *linophagana* » bezeichnet werden.

Diagnosen beider hätten zu lauten :

1. Cnephasia pyrophagana Rebel, ♂ und ♀.

Allgemeinfärbung weissgrau. Fühler bis 1/2 des Vorderrandes der Vfl. reichend, beim ♂ schwach verdickt, mit etwas abstehenden Gliederenden und sehr kurzer, schütterer Bewimperung. Die vorstehenden Labialpalpen überragen etwas die Stirne, besitzen ein gegen das Ende breiter beschupptes Mittelglied und ein sehr kurzes, nacktes, stumpfes Endglied. Sie sind durchaus hellstaubgrau gefärbt. Kopf, Thorax und Hinterleib ebenfalls staubgrau, zuweilen — namentlich beim ♀ — mit einem schwachen Stich ins Bräunliche. Die Beine weissgrau. Die Vordertarsen zuweilen (beim ♂) schwärzlichbraun gefleckt. Der zylindrische, gestreckte Hinterleib überragt mit 1/3 seiner Länge den Afterwinkel der Hfl. Seine Spitze ist mehr oder weniger ockergelblich. Er trägt beim ♂ einen kurzen, gestutzten Afterbusch, beim ♀ endet er stumpf. Der entschuppte Genitalapparat ist rötlichockergelb.

Die Vfl. (wie bei *pasivana* geformt) zeigen namentlich bei 1/3 ihrer Länge, einen stark gebogenen Vorderrand, steilen Saum und gerundeten Innenwinkel. Sie sind bei dem meist grüsseren ♂ breiter als beim ♀. Ihre Grundfarbe ist weissgrau, selten mit einem schwachen Stich ins Bräunliche. Beim ♂ sind die Vfl. meist ohne Spur einer Bindenzeichnung, nur mit schütterer grauer Bestäubung, namentlich gegen den Vorderrand. Einzelne schwarze Schuppen liegen gleichmässig verstreut auf der ganzen Flügelfläche. Oft durchzieht eine feine graue Staublinie die breiten, weissgrauen Fransen. Die Hfl. sind am Innenwinkel breiter als die Vfl., mit stumpf gerundeter Spitze. Sie sind staub- oder weissgrau, mit helleren Fransen, die nahe ihrer Basis meist eine undeutliche Teilungslinie führen.

Das kleinere ♀ mit etwas schmäleren Flügeln, zeigt auf den hellgrauen Vfl. meist eine ganz verwaschene Querbindenzeichnung, von der eine Schrägbinde nahe der Basis, eine zweite von 2/3 des Vorderrandes gegen den Innenwinkel ziehende, und eine ganz undeutliche Querbinde im Saumfeld zuweilen angedeutet sind. Auch nur graue Vorderrandsflecke können die sonst fehlende Bindenzeichnung andeuten.

Die Unterseite der Vfl. ist dunkler grau, mit helleren Fransen, jene der Hfl. wie oberseits. Vfll. ♂ 8-9, Exp. 16-18 mm., ♀ Vfll. 7-8, Exp. 14-16 mm.

Der Genitalapparat von *pyrophagana* ♂ und ♀ lässt sich mit den Abbildungen jenes von *Cnephasia pasivana* Hb. bei Pierce und Metcalfe

(Genital of Tortricidae, Liverpool, 1922, p. 11, Pl. 4, fig. 3) (ohne der Zeichnung spezifischen Wert zuzuerkennen !) vereinen.

Über die ebensweise der *pyrophagana*-Larve wird mitgeteilt, dass sie im März-April den Weizenhalm, oberhalb dessen obersten Knoten abfrisst, auch im Halm oberhalb des obersten Knotens lebt, oder auch an den Ähren nagt.

Von südeuropäischen Stücken der *Cnephasia pasivana* Hb. unterscheidet sich diese als erwachsene Larve auf Weizen lebende *pyrophagana* durch bedeutendere Grösse der ♂, viel lichtere Färbung, die der bräunlichen Einmischung fast ganz entbehrt, ferner durch die beim ♂ meist ganz fehlende Bindenzeichnung der Vfl. und hellere, reingraue Hfl. (vgl. Taf., fig. 9 und 10).

Noch näher kommt die artlich wahrscheinlich nicht zu trennende *Cnephasia fulturata* Filipjew (i.l.) aus Andalusien und Algerien, die allerdings etwas grösser ist und einen geraden Vorderrand der Vfl. besitzt (vgl. Taf., fig. 11 und 12).

2. **Cnephasia linophagana Rebel**, ♂ und ♀

Der vorigen Form (*pyrophagana* Rebel) überaus nahe und hauptsächlich nur durch die Lebensweise als Larve in den Kapseln von Flachs (*Linum*) verschieden. Die männlichen Falter (2 defekte Stücke ohne Hinterleib) sind etwas deutlicher als *pyrophagana* Rebel ♂ mit grauen Querwellen auf den Vfl. gezeichnet, die ♀ oft dunkler grau mit entschieden deutlicherer Bindenzeichnung der Vfl., aber von gleicher Anlage wie bei *pyrophagana* Rebel ♀.

Grösse durchschnittlich geringer als jene der *pyrophagana* Rebel, was mit der endophagen Lebensweise der Larve in den Samenkapseln des Flachses zusammenhängen mag.

Die Form *linophagana* steht der Nominatform *pasivana* näher, als der grösseren, lichteren *pyrophagana*.

Die Larve von *linophagana* lebt normal erweise in den Kapseln des Leins im April. Bis 10 % der Fechsung waren 1939 in Mit Chalaf von ihr befallen. Auf Flachskulturen, deren. Anbau keine örtliche Nähe zu Weizenfeldern hatte, wurde *linophagana* bisher nicht beobachtet.

Das Ausschen der Larven von *pyrophagana* und *linophagana* ist ein ganz übereinstimmendes (Priesner).

Nach Erfahrung österreichischer Mikrolepidopterologen bei der Zucht heimischer *Cnephasia*-arten, minieren die jungen Larven anfänglich in Blättern diverser niederer Pflanzen und suchen erst bei vorgeschrittenerem Wachstum geeignetere Nährpflanzen auf, um ihre Entwicklung zu vollenden. Eine zweite Generation ist nicht vorhanden.

Ähnlich dürfte auch der Lebenszyklus der ägyptischen *Cnephasia*-formen verlaufen. Die Eiablage wird wahrscheinlich im Mai an Ackerunkräuter,

vielleicht auch an vorhandene Leguminosen, erfolgen, das Wachstum der Larven dürfte während der heissen Sommermonate bei minierender Lebensweise ein sehr langsames sein, erst im Frühjahr würden die beweglicher gewordenen Larven ihre Nährpflanze wechseln und ihre minierende Lebensweise mit einer immer noch vorwiegend endophagen vertauschen, um sich schliesslich im Bereiche der neuen Nährpflanzen zu verwandeln.

Als bestes Bekämpfungsmittel dürfte sich — bei Zutreffen dieser angenommenen Lebensweise — die rechtzeitige Entfernung aller im Bereiche der gefährdeten Kulturgewächse stehenden Unkräuter, Ruderapflanzen, etc., erweisen.

Tafelerklärung

Fig. 1. — *Cnephasia pyrophagana* Rebel, ♂ : Mit Chálaf, 10.IV.1939, ex larva, on wheat.

Fig. 2. — *Cnephasia pyrophagana* Rebel, ♀ : Shoubra Zingi, on wheat, 18.IV.1935.

Fig. 3. — *Cnephasia pyrophagana* Rebel, ♀ : desgl.

Fig. 4. — *Cnephasia pyrophagana* Rebel, ♀ : on wheat, 20.IV.1939.

Fig. 5. — *Cnephasia pyrophagana* Rebel, ♂ (schmalflügelig) : Shoubra Zingi, ex larva, 27.IV.1935, on wheat.

Fig. 6. — *Cnephasia linophagana* Rebel, ♂ : éclos, 24.IV.1939, du lin.

Fig. 7. — *Cnephasia linophagana* Rebel, ♀ : Shebin El Kom, 13.IV.1939.

Fig. 8. — *Cnephasia linophagana* Rebel, ♀ : éclos, 24.IV.1939, du lin.

Fig. 9. — *Cnephasia pasivana* Hb., ♂ : Livorno, Mann 1872.

Fig. 10. — *Cnephasia pasivana* Hb., ♀ : Prater, Mann 1856.

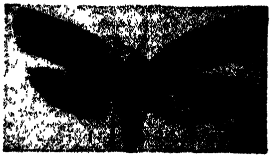
Fig. 11. — *Cnephasia fulturata* Filipjew, ♂ : Granada, Ende Mai 1925, Zerny.

Fig. 12. — *Cnephasia fulturata* Filipjew : desgl. Zentr. Alger, Hassih Beba, Mai 1930, Schwing.

(Vergr. 2 : 1)

Prof. Dr H. Rebel


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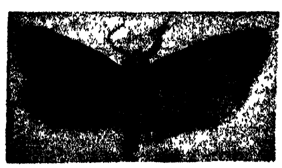

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Vorlaeufige Mitteilung über zwei Tortriciden als Kulturschaedlinge in Unteraegypten

Control of Tetranychidae (Red Spider Mites) in Egypt

[Acarina]

by Dr. M. TAHER SAYED

I found Mr. Steiner's paper (Zeit. Ang. Ent., XXVI, 1, p. 180, 1939) on the control of red spider mites very interesting and it induced me to write a similar note on the Tetranychid question in Egypt. The family *Tetranychidae* is well represented in this country. The following genera are found:

Tetranychus Dufour (1832), *Anychus* Mc Gregor (1913), *Tenuipalpus* Donnadieu (1876), *Raoiella* Hirst (1924), *Petrobia* Murray (1877), *Bryobia* C.L. Koch (1836), *Phytoptipalpus* Tragardh (1904), *Tetranychopsis* Canestrini (1890), *Phyllotetranychus* T. Sayed (1938), *Dolichotetranychus* T. Sayed (1938).

Although Tragardh has recorded *Tetranychopsis* in Egypt, the writer has not seen it yet. Only four or five genera are economically important. These are represented by the following species: *Tetranychus telarius* L., *Anychus latus* C. and F. (?), *Tenuipalpus* 2 nov. spp., *Dolichotetranychus floridanus* Banks, and to less extent *Raoiella indica* Hirst.

Tetranychus telarius is the commonest red spider mite in Egypt and infests fig plantations (especially in Fayoum province), all cucurbits, leguminous plants, and other vegetables. It occasionally infests some of the main crops as cotton and clover and could be found on several ornamental trees.

Anychus latus C. and F. (?) is the main citrus mite in Egypt. It is often found on *Ricinus communis* and some ornamental trees as *Melis azedirachta*. It is probably the same as *Anychus orientalis* Zacher (see Klein, 1936). The writer's description of this mite coincides to a great extent with that of Hirst. Infested fruits have a russety appearance before they are mature. In some orchards this pest is the main one when compared with other citrus pests. Not all citrus species are equally susceptible to this mite. Sweet lemon is more susceptible than orange and mandarine. Bitter lemon is the least susceptible. *Tetranychus* and *Tenuipalpus* spp. may be found occasionally on citrus.

Tenuipalpus 2 nov. spp.: The description of these mites will appear shortly. One of these is a pest of apples, pears, plums, peaches and few

ornamental trees and shrubs. Heavy infestation gives a brownish appearance to greenish fruits, especially apples and pears. The other species infests vine leaves and those of pomegranate as well as its fruit.

Dolichotetranychus floridanus Banks is the grass (*Cynodon dactylon*) mite in Egypt. It infests as well *Ananas sativus* Lindl., *Phragmites communis* and Halfa (*Eragrostis bipinnata*). Its symptoms on grass are unmistakable. Leaves are seen short, very close to each other with a stunted appearance. The mite is seen lodged between the overlapping leaves, and usually accompanied by a black fungus which is probably carried by the mite since this fungus has not been noticed alone. It is probable as well that the susceptibility to the fungus attack is indirect. Infested grounds have very short and brownish grass especially when the attack is rather old.

The *Ananas* (pine-apples) plantation is only limited to Inchas (in the Delta) in the private Royal estate where the mite could be seen at the base of the leaves giving it dark or light brown appearance. Of all the attacks examined, no black fungus was noticed, as in the case of grass. This mite was recorded by Banks (1915) as *Stigmaeus floridanus*. The generic name had to be changed since the *Stigmaeus* characters are entirely different.

Raoiella indica Hirst is a coconut pest in India but a date-palm one in Egypt. It has been seen infesting palm leaves while *Oligotetranychus (Paratetranychus simplex)* in Iraq and Algeria infests inflorescences and small green dates. The mite seems to be a more serious pest in the Sudan than in Egypt. Leaves, when heavily infested, look brown and rusty.

Methods of Control

Chemicals used against Tetranychids in Egypt are :

(1) Sulphur dust : Reduces the attack considerably but is less toxic to the egg which might hatch after dusting. Hence, another application would be sometimes necessary a week after the first to ensure its effect on the newly hatching larvae.

Dusting should be only applied early in the morning when the dew is present. If this is not available, artificial dew, i.e. slight spraying with ordinary water would be necessary just before dusting. The fact that rain is scarce in Egypt is helpful against washing off the dust. Sulphur is preferably used with tender foliage as in flowers, vine leaves, vegetables, etc. It has been found that rather heavy dusting, when the weather is very hot by day, may cause scorching to the vine-leaves. This occurred in a sandy soil near Alexandria but only to one particular variety. Again, heavy dusting on small watermelon fruits might scorch them when exposed to very hot sun during the day. Other sulphur dusting compounds are available on the market but the proportion of sulphur in these is rather low, and moreover their usual dark

appearance, due to iron compounds or dark carriers might affect photosynthesis.

(2) Lime-sulphur : Although very much used in Egypt and other parts of the world, it is not thoroughly investigated. Several ways of preparation are recorded in the literature. It is usually prepared in Egypt in the following ratio : one kilo quicklime : two kilos sulphur : twelve litres water. This ratio does not as a rule give more than 20° Baumé. It was found that when only 6.5 litres of water are used instead of twelve, the Baumé may rise up to 34°. In the Oregon experimental station lime-sulphur is prepared in the ratio : quicklime (stone lime) 50 pounds : sulphur powdered 100 pounds : water 50 gallons.

In other words the ratio is 1 : 2 : 8,5 (approximately). The Baumé of this preparation is bound to be over 20°. However, the ratio of lime to sulphur is occasionally reversed, as recorded by Bourcart. The formula is as follows :

22 lbs quicklime, 11 lbs flowers of sulphur and 22 gallons of water.

The addition of 2.2 gallons crude glycerine is recommended to decrease the scorching effect of the spray but this has not yet been tried. It is necessary to determine the amount of polysulphides or the effective ingredient in each of the different recommended preparations. Dilution is relative to the Baumé degrees, specific gravity, the weather and the plants, whether they are dormant or not.

It is extremely important to use quick or stone lime, and it is always advisable to assume about 10 % impurities in the lime and hance, use more than recommended or else, a great amount of sludge is formed and sulphur is wasted.

Lime-sulphur when tried on citrus, vine, and other plants does not spread as it should, and therefore, the addition of a spreader seems to be necessary.

The following spreaders (some of shich are also stickers) were found useful.

(a) Flour-paste : Only wheat flour is used because it is more gelatinous ; one pound of flour to four litres of water. This is heated and stirred continuously till the mixture thickens and becomes sticky. It is used 4 % when mixed with lime-sulphur. If the lime-sulphur dilution is 1 %, the formula would be as follows :

1 liter lime-sulphur, 4 litres flour-paste. and 95 litres water.

Flour-paste has been tried by itself as acaricide with a double proportion, namely 8 %, but it was not successful.

(b) Casein : Only 70 grams to each 100 litres spray were found sufficient. The distribution of lime-sulphur was even, and the foliage seemed deeper green when compared with that treated with other spreaders.

(c) Arabic gum or gelatine : 415 grams to 100 litres spray.

(d) Agaral (Imperial Chemical Industries compound) : 200 c.c. in 100 litres spray.

(e) Fenugreek flour (*Trigonella foenum-graecum*) : 300 grams for 100 litres. The fenugreek seeds are first roasted and then ground.

Scorching of citrus fruits when sprayed by lime-sulphur in summer occurs sometimes when least expected. Agricultural conditions and variety of fruit seem to be important factors. Navel oranges seemed to be more susceptible than other varieties to scorching.

(3) Sodium sulphide : Proved to be an excellent dormant spray when used against *Tenuipalpus* on apples, pears and plums. It was prepared in the following ratio :

Caustic soda 13.5 kilos, sulphur 20 kilos, water (warm) 12.5 gallons.

It was quite effective when used at 5% in winter, and it is probable that it could be effective in a low concentration. When used with flour-paste as in the case of lime-sulphur, the spreading would be ensured. Summer concentrations have not yet been tried.

(4) Potassium sulphide : This has been already used as acaricide by Massee of the East Malling Experimental Station, England. When tried here, 63 grams with 1/2 lb. of soap to each 100 litres, the result was not satisfactory.

(5) Sulphate of nicotine + soap: This is so far an ideal insecticide for aphis, but it is certainly less toxic against mites especially when compared with oil emulsions or lime sulphur. When fish oil soap, instead of the ordinary washing soap is used, better result is attained.

(6) Oil emulsions: Several oil emulsions were used of which the mineral oil emulsions proved to be the best. The Ministry of Agriculture oil emulsion "Nan" as prepared by Dr. Moh. Shafik is an excellent acaricide when used at 1%. The American Volk is also good, provided it is fresh and well emulsified. In some cases, there was scorching as a result of separation.

Oil emulsions are more safely used in summer, especially on citrus, when sulphur compounds are liable to scorch the fruits on a very hot day.

This is only a general survey of acaricides tried by the Entomological Section, Ministry of Agriculture, in Egypt; but there is a good example in which any direct chemical acaricide fails. It is *Dolichotetranychus floridanus* which infests the grass *Cynodon dactylon* in Egypt. The mite is lodged between the leaves of the tightly overlapping leaves. It recently caused considerable damage in the sporting clubs at Maadi, Gezirah and other places near Cairo. Dusting with flowers of sulphur, spraying with lime-sulphur and oil emulsions were tried but in vain. It was noticed that grass growing in a poor soil is more susceptible to the attack. Only agricultural methods could in

this case succeed. In Maadi, the growing part of the grass above the ground was shaved so as to remove the infested portion, and then destroyed. Different manures were added to different plots of the ground which is almost pure sand. Best results were attained in the plots where stable manure + ammonium sulphate were applied. It was also found that the deficiency of clay accounts much for the attack, although the mite also occurs in the clay ground of the Ministry of Agriculture.

As to its control on Ananas, this has not yet been tackled ; but it seems that dusting or spraying the plants from the tops (so that the chemicals could reach the leaf-bases) would give results.

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Séance du 29 Mai 1940

Présidence de Monsieur le Professeur H. C. EFFLATOUN Bey.
Vice-Président

On some Thysanoptera *(Thripidae)* from Palestine and Cyprus

(with 1 Illustration)

by Prof. Dr. H. PRIESNER

1. Oxythrips uncinatus spec. nov.

Female : Brown to dark brown, legs dark, fore tibiae cloudily shaded, tarsi yellowish; joints 1, 2, and 4-8 dark, 3 yellowish, more or less strongly shaded, pedicel yellow ; joint 4 sometimes paler at extreme base ; wings shaded with a more or less pale grey or grey-brown ; major bristles of the body dark ; ocellar pigment red.

Head length from eyes 102 (total length 110-114), eyes 55 μ ; cheeks 47-51 μ long, slightly convex, head somewhat broader across cheeks (142 μ) than across eyes (130 μ) ; vertex with anastomosing cross-wrinkles which lie not very dense ; four small postocular microsetae situated in an oblique line on either side behind eyes ; hind ocelli about 24 μ distant from each other ; *interocellars small*, 20 μ not surpassing in length ; mouth-cone well developed, reaching mesosternum ; maxillary palpi slender, joints 20, 11 and 17 μ long. Antennae length about 260 μ ; measurements of joints (of holotype) in μ : 22(29), 39(26), 45(20), 41(20), 36(22+), 43(20-21). 8(8-8.5), 14-15 (5) ; joints normal, 5 with sides much convex, the longer sense-cone of joint 6 reaching middle of the following joint ; style *moderately* slender.

Pronotum, length 118 μ in holotype (106 in other specimens), width 185 μ, distinctly widened towards base, sides little arched. disk with ca. 20 pairs of microsetae, apart from the 5 pairs of the fore margin, the four pairs of inner postero-marginals, and the 1 situated by the long postero-angulars ; the latter measure 35-47 μ : *fore tarsi with a claw at extreme apex*, which

is very distinctly developed (Fig. 1), and much longer and more conspicuous than in *Oxythrips ajugae* Uz.

Pterothorax width 250, length (from fore margin to base of hind coxae) 260-268 μ; inner bristles of base of metascutum (I) far apart from fore margin of it, shorter (20 μ) than the lateral setae (24-28 μ) which are situated at the fore margin; metascutum (I) coarsely but faintly reticulated medianly; wings (length 709-840 μ) moderately broad, veins visible; costa with well 30, upper vein with 4+3 basal and 1+2 *small* distal bristles, lower

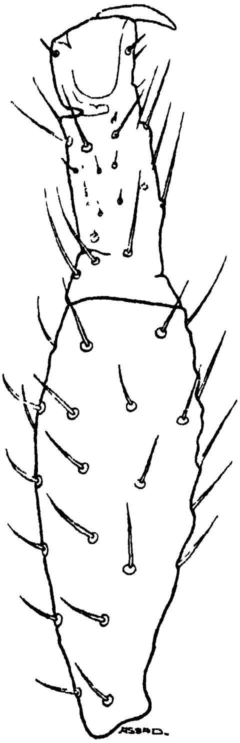


Fig. 1. — *Oxythrips uncinatus* spec. nov.: Fore tibia and fore tarsus of the female.

vein with 10-13 (mostly 13) bristles which distinctly increase in length towards tip of wing; scale with 5(6)+1 bristles.

Tergite II of the abdomen *at lateral margin with but 2 bristles,* one of which is situated about the middle of the lateral margin, the other one at hind angles; there is only a porus about fore angles but no bristle nor microseta. Porus on tergite VIII on a plane between the dorsal bristles and the hind margin; comb wanting; accessory sternite bristles wanting. Dorsal bristles on segment IX vestigial (reduced to microsetae), those of hind margin

b.1,2 : 91-99, b.3 75 μ long; bristles on segment X, b.1 : 75, b.2 : 63-67 μ long. Length of segment IX, 77-80, of X, 63 μ; ovipositor length about 256 μ. Hind tibiae with 7-8 bristles at inner margin (beside the apical spurs). — Total body length (normally distended) 1.16 to (distended) 1.44 mm.

Habitat : Palestine, a few females, collected by Dr. E. Rivnay at Caduri Tabor, on 20.4.38, on oak (*Quercus*) leaves; 2 females from the same locality, 11.3.38, from buds of *Quercus*.

Among the species armed with a tarsal tooth, in *Oxythrips ajugae* Uz. the tooth is, though homologous, much shorter and less slender, and therefore less conspicuous, besides, *Oxythrips ajugae* is a less slender species and coloured differently (either yellow or, head and thorax orange, abdomen brown); *Oxythrips flavus* Moris. has prothoracic setae much longer (72 μ), apart from its different colour; *Oxythrips dentatus* Kn. (see below) has longer, tubiform abdominal segment X, and has the tarsal tooth stouter and situated at apex of first tarsal joint and not at apex of bladder, and so on.

2. Oxythrips claripennis spec. nov.

A typical *Oxythrips*. — Among the unarmed species, differing from *euxinus* Kn. by the hyaline wings, the longer postero-angulars of the prothorax, and the greater number of lower vein bristles; *forticornis* Bagn. is a much tenderer species, as it appears from the measurements of the antennae, moreover, it has the mouth-cone longer and more pointed, and but 8-9 lower vein bristles; of *halidayi* Bgn., a macropterous form is not known yet, this species has however, in any case, much darker antennae; *inopinatus* Pr, has antennae slenderer, and the whole body is much less compact; *tamaricis* Bagn. is similar in shape but postero-angulars of pronotum are much shorter. wings shaded towards tip, and the minute but dark lower vein bristles are less in number; *pernicis* Bgn. is a smaller form, though not sufficiently described; *quercicola* Bagn., a pale species, has dark wing bristles, colourless joint 1 and pale joint 2 of the antennae, slightly shaded wings, but may be similar in the shape of the antennal joints; *tristis* Bgn has antennal 6 shorter, and only 8 lower vein bristles, whilst its wings are similar to those of *tamaricis*, in colour; dark specimens of *ulmifoliorum* Hal. which finally might be compared with *claripennis* n.sp., have their interocellar setae vestigial.

The new species is particularly recognizeable by its dark colour combined with the wholly hyaline wings and pale wing setae; its habitus is about that of *tamaricis* Bagn.

Female: Dark brown, abdomen nearly black-brown, thorax somewhat lighter, hind marginal line of vertex blackish. Legs dark, fore tibiae yellow from the middle towards apex; at margins, the dark colour extends farther towards apex of tibia than interiorly; middle and hind tibiae yellowish at

extreme tips; tarsi yellowish. Antennal joints 1, 2 and 6 to 8 wholly dark (dark grey-brown to black-brown), joints 3-5 paler, 3 and 4 with uniformly greyish shade (i.e. not clear yellow), 5 yellow but basally or in basal third. the rest strongly shaded with grey-brown. All major bristles of the body dark. Wings wholly hyaline (not yellowish), bristles pale or very slightly shaded.

Head broader than long, broader across cheeks than across eyes, cheeks slightly rounded, vertex cross-wrinkelled above, and therefore *slightly* serrate laterally; interocellar setae situated on or just outside the "tangent", very well developed, surpassing the hind ocelli; postocular series of micro-setae somewhat irregular (3 + 1); two pairs of ante-ocellars well visible. one situated at inner margin of eyes on the same plane as the front ocellus, the other in front of this plane, with the inter-ocellars in one longitudinal line; micro-setae between the ommatidia inconspicuous. Antennae moderately long, joint 1 short, with strongly rounded sides, 2 normal, 3 pedicelled, much widened towards apex; sense-cones normal, strongly curved; micro-setulae of intermediate antennal joints distinct; joint 5 much rounded at sides, 6, though slender basally, not constricted, its major sense-cone moderately long, not reaching tip of antenna; joint 8 much longer than 7, style, therefore, slender. Mouth-cone short.

Prothorax of very moderate size, in comparison with head, sides little rounded; fore margin with 4-5 pairs of micro-setae, disk with about 10 pairs, hind margin with 3-4 (normally 4) inner and 2 outer pairs of micro-setae which are separated by one macro-seta (postero-angular bristle) of 39-47 μ.

The median of the two pairs of setae on the metascutum is somewhat longer than the outer, and somewhat distant from base. Wing bristles almost as clear as the wings themselves, or but slightly shaded, veins clear but distinctly visible, costa with about 30, upper vein with 4 + 3 (4,5) basal, and 1 + 1 + 1 distal, lower vein with 11-13 bristles

Tergite VIII with its pores situated in the space between the dorsal bristles and the hind margin; comb wanting; accessory sternite bristles wanting; segment X split above nearly down to its base. Bristles at hind margin of segment IX strong, the dorsals weak (about 14 μ).

M e a s u r e m e n t s (of holotype) in μ: Head length from eyes 110, total length 122, width across eyes 144, across cheeks 150; eyes diameter 51-55; cheeks behind eyes 63; inter-ocellar bristles 28-32; inner distance of hind ocelli 32; antennae total length 243; joints 17 (29), 36-39 (27), 42-45 (22), 38-39 (22), 34-35 (22), 46-48 (20), 9.5-10 (8), 15-17 (5-6). Prothorax length 114, width 173; postero-angular bristles length 39-47. Pterothorax width 230-245; wings length 623-692 (several specimens), width behind scale 77-79. Abdomen, segment II length 70, segment IX length 63; bristles on segment IX, b. 1-3, 87-102; bristles on segment X, b. 1 75, b. 2 59-63; ovipositor length 188-193.

Total body length (normal length to slightly distended) : 1.04-1.23 mm.

Habitat: Cyprus, Amathus, 2.2.40, collected by Mr. G. A. Mavromoustakis (N° 40/2) on an unidentified shrub (4 specimens).

3. Oxythrips eryngii spec. nov.

Female (f. macroptera): Body light brown to orange-brown in front, abdomen dark brown. Antennal joints 5-8 dark, as dark as the abdomen, 5 light at pedicel, joints 1-4 much paler, 3 yellow, 1, 2 and 4 more or less slightly shaded with grey. Legs pale yellow, fore femora at outer margin, middle and hind femora at both margins shaded with grey, middle and hind tibiae mostly with pale greyish ring, or the hind tibiae very slightly shaded at exterior margin; tarsi pale yellow. Wings uniformly pale yellowish. Major body and wing bristles dark. Ocellar pigment orange.

Head large, moderately transverse, cheeks somewhat longer than eyes, vertex slightly transversely striate, interocellar bristles well developed, distinctly surpassing hind ocelli and inserted in or somewhat inside tangent; ante-ocellars arranged in a shallow arc, the lateral ones on the same plane as the front ocellus, the middle ones somewhat in front; the series of post-ocular micro-setae consists of about 3 pairs, the innermost of which being inserted far apart from the hind ocelli. Antennae similar to those of *claripennis*, style slender, but joints 5 and 6 somewhat pedicelled at base, whilst in *claripennis*, joint 6 is broader at base. Mouth-cone normal, maxillary palpi of moderate length.

Prothorax, in comparison with head of moderate size, scarcely narrowed anteriorly, disk with only about 13 pairs of micro-setae, fore margin with 6(7) pairs, hind margin with 3-4 pairs inner and two outer micro-setae, and one postero-angular between them, the latter measuring 43-47 μ in the f. macroptera (33-37 μ in f. brachyptera). Fore tarsi unarmed.

Pterothorax normal, metascutum with indistinct net-like structure, medianly; the central pair of bristles on the metascutum, situated in the middle of this segment, rather light, tender, somewhat larger than the lateral pair, which is situated at the fore margin. *Wings much varying in length*, and therefore also in the number of bristles on their veins; these bristles are dark, much longer towards tip than at base; in the holotype, costa with 24, the upper vein with 4+2(3) basal, and 1+2 distal bristles; 12 bristles on the lower vein and 5 on the suture of the scale; in another specimen, only 18 costal bristles are present, with 4+3 basal and 1+1 distal upper vein bristles, and 7 lower vein bristles (with 5 on the scale suture).

Tergite I of the abdomen with pori very close to hind margin; tergite II with but two lateral bristles; tergite VIII without comb, its pori scarcely behind a cross-line on which dorsal bristles 1 and 2 are situated; accessory

sternite bristles wanting. Bristles on hind margin of segment IX, strong, dark. Base of segment X split nearly down to its base.

Measurements (of holotype) in μ: Head length from eyes 110, total length 122, width across eyes 128-136, across cheeks 138-146; eyes diameter 55-59; cheeks length behind eyes 59-63; inner distance of hind ocelli 28-30; antennae total 234-242; joints, ? (27), 36 (26-27), 39-41 (19-20), 34 (18-20), 31-32(17-18), 42(18-19), 8(6-7), 14(4-5); inter-ocellar bristles length 28-30. Pronotum length 122, breadth 173; postero-angular bristles 43-47. Median bristles on metascutum 16-18; pterothorax breadth 200-235, length 173-200; wings length 675 (of paratype 520). Abdominal segment IX length 63, segment X 61-71; bristles 1-3 of segment IX 106-118, b.1 of segment X 95-99, b.2 83.— Ovipositor 200-205 μ long.

Female (f. brachyptera): Colour similar, but sometimes head and thorax more strongly shaded so that they do not contrast so much with the abdomen as it is the case in the typical specimens. Wing pads 165-210 μ long, with 1 + 7 (8) costal, 6-8 longitudinal (upper) vein, and 5 sutural (scale) bristles, and sometimes, in addition, 3 lower vein bristles; veins indistinct. Bristles on segment IX 95-102, those on hind angles of prothorax 33-37 μ long.

Habitat: A few females were taken by Dr. E. Rivnay, 20.3.36, on *Eryngium creticum* at Gedera, Palestine.

This species differs from *ajugae* Uz., which is similar in colour, and *pernicis* Bgn. by the lack of the tarsal tooth, from *euxinus* Kn. and *forticornis* Bgn. by the longer bristles on pronotum and abdomen (of the macropterous form), from the latter also by the normal mouth-cone: *quercicola* Bgn has antennal joint 1 pale, abdomen but with transversal shadings on the tergites, and the bristles on segment IX are much shorter; of *halidayi* Bgn., there exists a brachypterous form in which, however, antennal 1 and the whole body are much darker, and the postero-angulars of the pronotum are much longer (53 μ); *tristis* Bgn. has dark tibiae and much darker antennae, the wings are shaded towards tip, but it agrees with the new species in having joint 6 of the antennae constricted at base; in *tristis*, the postero-angulars of the pronotum are much shorter; *claripennis* Pr. is similar but has uniformly coloured body, base of antennae much darker, and joint 6 much thicker at base, not pedicelled (as joint 5) but only narrowed; wings and also their bristles are hyaline, in *claripennis*.

Pseudoxythrips subgen. nov.

As *Oxythrips* s.str., but fore tarsi within, at tip of joint 1 with a conspicuous tooth, both veins of fore wing for all their length rather evenly set with bristles. The single macro-seta at hind angles of pronotum comparatively short. Branches of forked sense-cones rather straight. Fore femora somewhat enlarged, apex somewhat turned up exteriorly.

Typus subgen.: *Oxythrips dentatus* Knechtel.

From *Pseudothrips* Hinds (typ. gen. *Ps. inaequalis* Beach), the new subgenus of *Oxythrips* is distinguished by the presence of the tarsal tooth, and in the position of the bristles 1 of the tergites, which are widely separated and very small, whilst they are close together on the anterior tergites, in *Pseudothrips*.

4. Oxythrips dentatus Kn. var. umbraticornis nov.

Female: Dark brown, fore tibiae pale in the middle, longitudinally, much shaded at both margins, fore tarsi pale yellow, middle and hind tarsi grey-yellow to yellow-grey; antennae dark brown, joint 4 not or only slightly lighter brown, 3 yellowish grey-brown, extreme base pale yellow; 2 somewhat paler at tip: major body bristles dark; wings strongly shaded all over, with oval hyaline areola before base of lower vein.

Head moderately large, with large eyes which are, however, laterally not at all convex, cheeks straight (or perhaps very slightly narrowed towards base), eyes scarcely pilose; vertex slightly cross-lined; posterior ocelli situated about the posterior third of eyes; inter-ocellar setae *small* (about 16 μ), far behind, in or somewhat behind a line across hind margin of posterior ocelli, close to each other (distance 11-12 μ); post-ocular series of micro-setae consisting of five dorsals reaching the inter-ocellars, in an uninterrupted arc, close to eyes; two pairs of ante-ocellar setae in front of eyes, a third pair close to inner margin of eyes, on the same plane as the front ocellus. Mouth-cone short, maxillary palpi moderately long, 3-jointed, joint 2 about as long as broad. Antennae short, sides of joint 1 convex, joint 3 with slender pedicel, joints 3-5 with rather distinct ringlets, *the forked sense-cones short, their branches scarcely bent*, like a pair of compasses, not crescent-shaped; intermediate antennal joints strongly convex laterally, 5 much constricted apically, 6 fusiform, thin at base, but not pedicelled; joint 2 of style much longer and slenderer than joint 1; major sense-cone on joint 6 not more than 14 μ long, reaching or somewhat surpassing the middle of joint 7. Prothorax strongly transverse, sides slightly narrowed anteriorly, disc not distinctly sculptured, with about 15 pairs of discal miscro-setae, besides, with 5 pairs of antero-marginal and 4 inner and 2 outer pairs of postero-marginal micro-setae, 1 pair of 22-24 μ long postero-angulars which are darker than all other postero-marginal bristles; fore femora enlarged, the exterior apical margin somewhat turned up, fore tibiae stout, fore tarsi with a strong tooth at apex of inner margin (not at tip of bladder). Mesonotum very faintly transversely striate, *metascutum (!) longitudinally striate*, the two pairs of bristles near base of about equal length. Wings broad, veins conspicuous, costa with about 26 setae (short at base, longer towards tip of wing), upper vein with a series

of 15-16 (4+11 or 4+12), lower vein with 11 setae; the distances of the setae on upper vein are not always quite regular. Dorsal bristles of tergites of abdomen very small, b.1 widely separated, longer on tergite VIII; on the latter tergite, the micro-pores are situated between b.1 and the hind margin, a little nearer to the latter; hind margin of tergite VIII slightly undulated, without comb; sternites without accessory bristles; postero-marginal bristle of sternite VII at a greater distance from hind margin than the other marginal bristles of this sternite; dorsal bristles on tergite IX small, the others long, particularly b.3; b.1 on segment X longer than b. 1 or 2 of segment IX; segment X moderately elongate (about as in *Thrips hukkineni*), perhaps shorter than in the typical *dentatus*, split above for nearly its entire length. Series of bristles at inner margin of hind tibiae consisting of only about 5-6, the two terminal spurs stout, dark.

Measurements (of holotype) in μ : Head length 106, total 114, width across eyes 128-130, across cheeks 138; distance of posterior ocelli 24; eyes, lateral diameter 55-59, dorsal diameter 59-63; inter-ocellar bristles about 16; antennae, total length 225-235; measurements of joints 20(25), 34(25), 38-39 (1) (20), 35(20, 29(19), 42-43(18), 7(7), 13-14(5). Pronotum length 120, breadth 185; postero-angular bristles length 22-24, median bristles on metascutum length 22; pterothorax breadth 250, length 277; wings length 760, width behind scale 70. Lengths of abdominal segments, II 73, VIII 73, IX 55, X 87; dorsal bristles on segment IX 16-18, postero-marginal b.1 79-91, b.2 93, b.3 114-122; b.1 of segment X 118, b.2 106-115; distance of b.1 of segment X from apex of this segment 36. Ovipositor length 210. — Total body length (much distended) : 1.46 mm.

Male : Colour as in female, smaller; most of morphological characters the same. Sternites III-VI (six) with dot-like glandular areas, measuring e.g., 28(16), 22(16), 24(14), 20(12) μ; lateral bristles on segment IX 67 μ long, the more strongly curved bristles of segment X 87-91 μ long; tergite IX with three pairs of rigid bristles which however cannot be called spines, the 2nd pair of which is 28-32 μ long, and its elements are close together. — Measurements in μ : Head length from eyes 100, total 106, breadth 130; antennae, 20, 31-32, 39, 34, 28, 41-42, 8, 13; maxillary palpi 11, 6. 11. Length of fore tibiae 90.

Habitat : 1 female (holotype), Palestine, Ein Harod, 23.3.36, on *Trifolium purpureum;* males and females, Safed, 16.4.36, in flowers of *Matricaria* spec.; female, Nahalal (without date), in Composite flower; 1 female, Benjamina, 24.3.36, on *Anthemis;* males and females, Beit Kerem, 30.3.36, on *Anthemis;* a few males, Zichron Yakouv, 22.2.38, on *Allium.*

I have given a more detailed description of this form, as I am not

(1) Lengths of joints varying from 36-46 μ, and 35-41 μ, respectively.

certain whether it represents the winter form of *O. dentatus* Knechtel or it is a distinct species. The differences are slight. The head, as well as the bristles of the pronotum of *O. dentatus* Kn., as figured on pl. IX (Thysanoptere din Romania, 1923), are no doubt much shorter in nature; though I have seen the type some fifteen years ago, I naturally can no more recollect any details, but I believe that the last abdominal segment is only slightly longer in *dentatus* than in *umbraticornis*. The only unquestionable difference between the two forms consists in the colour of the antennae, which is much paler in *dentatus*, with joint 3 yellow, joint 4 shaded but in distal third, *and joint 5 yellow about middle, dark at base and apex.*

In any case, even if the form *umbraticornis* will remain in our system only a variety (winter form) of *dentatus*, the more elaborate description given above — as such is usually not done in case of varieties — may be taken as emendation of the somewhat antiquated descriptions, given by Knechtel (l.c., p. 118) and myself (Thys. Eur., 1926, p. 211).

Peladothrips gen. nov. (2)

Body and legs slender. Head longish, not produced in front, eyes bulging, coarsely facetted, strongly pilose. Antennae 7-jointed, as in *Thrips* L. No prominent or additional ante-ocellar setae, no *posterior* occipital setae, but the anterior post-ocular series of micro-setae present. Maxillary palpi 3-jointed (in some cases, as in *Thrips* L., suture between joints 2 and 3 indistinct). Prothorax with two pairs of *long* postero-angular bristles, disc with conspicuous, somewhat erect micro-setae. Fore tibiae unarmed, *fore tarsi with two distinct hooks, side by side, at apex of tarsal joint 1 within.* Metascutum (I) longitudinally striate, not reticulate. Both veins of fore wing regularly set with bristles (as in *Frankliniella*), suture of scale with 5 bristles. Legs with somewhat raised setae. Abdomen normal.

Male unknown.

Typus generis : *Peladothrips biunculatus* sp. nov.

Near *Mecothrips* Karny, *Isoneurothrips* Bagn., and *Thrips* L. (Sbg. *Isothrips* m.). Differing from *Mecothrips* by the normally arranged interocellar bristles and the regular rows of wing bristles, from *Euchaetothrips* by the absence of long hairs on the tibiae and on the sides of the prothorax. and also by the chaetotaxy of the wings, from the subgenus *Isothrips* nov. (3) of

(2) ὁ, ἡ πέλας = the neighbour.

(3) In the subgenus *Isothrips* (of *Thrips* L.) (typ. subg. *Isoneurothrips orientalis* Bgn.) I include those species of *Thrips* (s.str.) in which the series of wing bristles is fairly regular and uninterrupted (more or less), as in *I. orientalis* Bgn. which is not a true *Isoneurothrips* Bgn. (typ. gen. *Ison. australis* Bagn.), the latter genus distinguished from *Thrips* L. by the closely spaced and shorter wing bristles and the presence of regularly 6 bristles at the scale-suture of the fore wing.

Thrips L. by the entirely regular rows of bristles of the veins of the fore wings, and the presence on the fore tarsi of a pair of curved teeth: *Isoneurothrips* is, apart from the last named character, generically distinguished by the presence of six setae at the suture of the wing scale. One might consider *Peladothrips* as a subgenus of *Thrips* L., but in this case, *Sminyothrips* Uz. (1895) would have to be treated alike a genus which is more closely related to *Thrips* than is *Peladothrips*.

5. Peladothrips biunculatus spec. nov.

Female: Dark brown, legs dark, fore tibiae lighter about distal half (dull yellow), tarsi yellow, more or less slightly shaded with grey; antennae dark, joint 3 pale yellow, 4 darker, yellowish grey-brown, 5-7 dark, 5 somewhat lighter than 6, 4 and 5 with white ring immediately before base Body bristles moderately dark, or slightly shaded. Wings shaded with grey-brown throughout their length.

Head appearing longish, as long as broad, *constricted* between eyes and cheeks, the former bulging, the latter convex, facets of eyes large, and setulae between them rather unusually conspicuous; hind ocelli situated about the posterior quarter of eyes, inter-ocellar setae distinct, moderately long, at the sides of the front ocellus, somewhat outside the "tangent"; 1 pair of ante-ocellar bristles present at inner margins of eyes, somewhat before their middle, and being of about the same length as the inter-ocellars. Vertex slightly transversely striate; behind eyes, a series of post-ocular micro-setae, consisting of about 7 (5 dorsally, 2 laterally) elements; the post-oculars proper are wanting. Mouth-cone normal, maxillary palpi slender, 3-jointed, joint 3 somewhat thickened at base so that the suture between joints 2 and 3 sometimes appears somewhat obsolete. Antennae slender, intermediate joints long, also joint 1 rather elongate, 3 with white membraneous sub-basal ring behind pedicel, not constricted before apex, sense-cones forked, slender, moderately long; joint 5 but slightly narrowed before tip, and therefore fairly broad, apically; joint 6 neither constricted nor pediceled basally, the major sense-cone of it little surpassing apex of joint; style moderately long, broad at base. Prothorax slightly narrowed towards apex, with a rather fine furrow just within hind margin; postero-angular bristles long, hind margin with 3-4 pairs of smaller setae within: disc set with comparatively conspicuous somewhat erect setae, of which 5 or 6 occupy the fore margin, 14-16 pairs the disc itself. Fore legs rather stout, femora and tibiae set with moderately long, semi-erect setae; fore tarsi slender, with two curved teeth side by side at apex within (not at apex of bladder), and with two small setae between base and apex of joint 1 within, emerging from rather fine tubercles which are but visible when viewed from the side. Metascutum (T) densely longitudinally striate, *not* reticulated, its median pair of setae a little apart

from fore margin, whilst the other, lateral, pair emerges from the fore margin. Wings long, very moderately broad, bristles long; costa with about 30, upper vein with 19-20 throughout its length, lower vein with the same number of bristles; the fore wing appears to be somewhat paler longitudinally, between the veins; scale at its suture with 5 (rarely 6) bristles. Sides of tergite II of the abdomen with 3 bristles, b.2 of the dorsal bristles of this tergite very close to the lateral margin (and therefore close to b.1 of the lateral margin); tergite VIII with complete comb; pori situated in the middle between b.1 and hind margin; sternites without accessory bristles; b.1 of those of hind margin of sternite VII far apart from the margin, even b.2 a little distant from it; bristles on segment IX well developed, normal; segment X split above towards basal third (or more), but often connected about the bases of bristles 1. Hind tibiae within, almost throughout their length, with 12 yellow bristles, beside their spurs.

Measurements (of holotype), in μ : Head length (from eyes) 138, total length 150, width across eyes 150, across cheeks 144-146; lateral diameter of eyes 71-79; interior distance of hind ocelli 32; inter-ocellar bristles length 24-28; maxillary palpi 11-13, 11-13, 18-20; fore tibiae length 140; antennae length 320-330; joints, 31-34 (b.31, about 28), 49-50(27-28), 66(20), 55(21), 45-46(18), 59(22), 21(10); pronotum length 150, breadth about 197; postero-angular bristles, exteriors 79-83, interiors 83-87; pterothorax breadth 260-277, length 310; dorsal bristles on segment IX of abdomen 43-47, marginals (b. 1-3) 118-122, 126-130, 142; bristles on segment X, b.1 126-134, b.2 122; segments VIII-X length, 102, 63 and 63 respectively. Wings length 934, breadth behind scale 80. Ovipositor length 230. — Total body length (distended) : 1.49-1.59 mm.

Male unknown.

Habitat : Palestine, Zichron Yakouv, 22.2.1938, females in numbers in the flowers of *Silene atocion;* one female each, on the same date and at the same locality, but in 1932, in flowers of *Cyclamen* spec., *Silene* spec. and *Senecio vernalis.*

Séance du 12 Juin 1940

Présidence de Monsieur le Docteur SAADALLAH MOHAMED MADWAR

Subventions :

Grâce aux démarches entreprises par notre Président, Monsieur le Professeur MAHMOUD TEWFIK HIFNAOUI Bey, la SOCIÉTÉ ROYALE D'AGRICULTURE nous a octroyé une subvention annuelle de L.Eg. 50, et l'IMPERIAL CHEMICAL INDUSTRIES (EGYPT) S.A. une subvention annuelle de L.Eg. 25.

La Société remercie Son Altesse le Prince OMAR TOUSSOUN, Président de la Société Royale d'Agriculture, et Monsieur STENER VOGT, Directeur de l'Imperial Chemical Industries, pour leur généreuse contribution au développement de notre Société.

Dons à la Bibliothèque :

La Société a reçu les ouvrages qui suivent :

1° De Monsieur ANDRÉ JANSSENS, de Bruxelles (Belgique) : un exemplaire de sa « Monographie des *Scarabaeus* et genres voisins », publiée dans les Mémoires du Musée Royal d'Histoire Naturelle de Belgique, 2e Série fasc. 16, pp. 1-82 et 3 planches, Bruxelles, 1940.

2° De Monsieur PETER W. WYGODZINSKY, de Bâle (Suisse) : un tirage à part de ses deux récents travaux (a) " Eine *Maindronia* (Lepismatidae Thysanura) aus Südamerika », (b) « Beiträge zur Kenntnis der Dipluren und Thysanuren der Schweiz », publiés dans les Verhandlungen der Naturforschenden Gesellschaft in Basel, Vol. LI, pp. 25-28 et 40-64 respectivement. Bâle, 1940.

3° De Monsieur G. A. MAVROMOUSTAKIS, de Limassol (Chypre) : un separata de ses trois récentes études des Anthidiinae (Hymenoptera-Apoidea) africaines et asiatiques, publiées dans les Annals and Magazine of Natural History, Ser. 10, Vol. XVII, pp. 31-47 et 600-607, 1936, et Ser. 10, vol. XIX pp. 151-157, 1937 respectivement.

Le Conseil remercie les généreux donateurs.

Dons de Planches murales :

La Société a reçu les planches murales en trichromie, d'une parfaite éxécution, des sujets ci-dessous mentionnés :

1° Courtilière [don ANTOINE CASSAB].

2° Coccinelles (*Epilachna chrysomelina* et *Coccinella 11-punctata*) [don BOUTROS LABIB SOLIMAN].

3° Bruchides des fèves, lentilles, haricots et pois chiches [don RIZK ATTIA].

Le Conseil remercie.

Notes on Parasites and Predators of Coccidae and Aleurodidae in Egypt

by Prof. Dr. H. PRIESNER
and
MAHMOUD HOSNY, D.I.C., F.E.S.

For several years we have been collecting and rearing scale insect and white fly material, with a view of obtaining some knowledge on the insects parasitizing, or feeding on, the *Coccidae* and *Aleurodidae* of this country.

The material obtained, for the most part consisting of parasitic Hymenoptera, had to be sent to specialists for identification, and various authorities, particularly on *Chalcidoidea*, were kind enough to study the parasites in question. We are, therefore, much indebted to Dr. S. Novicky (Thorn) and Dr. H. Compere (Berkeley), for having named some of these insects; the major part of them was identified by Dr. C. Ferrière of London. Several records on Coccinellidae are taken from Mr. A. Alfieri's collection.

The following list of parasitic and predaceous insects is a preliminary one. Several doubtful species have not yet been included. The list should only serve as a base for further studies on this subject. The order is alphabetical.

A. List of parasites and predators

I. Hymenoptera

1. *Achrysopophagus aegyptiacus* Mercet (*Encyrtidae*). — Bred by Alfieri from material of *Zilla*, infested with *Coccidae* (together with *Scymnus* and *Exochomus*).

2. *Anagyrus pseudococci* Gir. (*Encyrtidae*). — A common and efficient parasite of *Phenacoccus hirsutus* Green (Hibiscus mealy bug).

3. *Anagyrus greeni* How. — This species is recorded by a note of Mercet in Bull. Soc. Roy. Ent. d'Egypte, 1925, p. 46.

4. *Anicetus africanus* Gir. [= *Paracerapterocerus africanus* Gir.] (*Encyrtidae*). — Recorded by Mercet in Bull. Soc. Roy. Ent. d'Egypte, 1925, p. 53, fig. 2. — Bred by A. Alfieri from *Ceroplastes africanus* Green (attacked also by *Coccidiphaga scitula* Rmb.), on *Tamarix*; Wadi Kom (Asswan), 3.IV.1929; from *Ceroplastes africanus* Gr. on sunt (*Acacia arabica* var. *nilotica*), collection Ministry of Agriculture.

This species as well as the following are uncommon.

5. *Anicetus italicus* Masi. — Dr. Ferrière has given this name to a specimen bred on 12.IX.1929, from *Lecanium longulum* Dougl. (on *Acacia arabica* var. *nilotica*), taken at Kafr Zayât (Ministry of Agriculture).

6. *Aphytis chrysomphali* Merc. (*Aphelinidae*). — This is a very common minute species of polyphagous habits and is considered as one of the more valuable enemies of Diaspine Coccids. It breeds on *Aonidiella aurantii* Mask. and *Chrysomphalus ficus* Ril. (both on *Citrus*), but was also observed on *Chrysomphalus* (*Mycetaspis*) *personatus* Comst. (on *Mangifera indica*), and *Parlatoria oleae* Colv. (on olive), the latter record, however, was not confirmed since 1930. *Aphytis chrysomphali* Merc. is prevalent from June to February, may reach its greatest abundance in autumn, whilst it is scarce the remaining part of the year (February to May). It was taken all over the Delta, from Alexandria south up to Giza Province.

7. *Aphytis diaspidis* How. (*Aphelinidae*). — This form is not uncommon on *Parlatoria oleae* Colv., and was bred from scale material from apricot, pear, rose, oleander and *Ficus* spec. It is distributed over the Delta and was observed in the Nile valley as far south as Qena. Our records are from April.

8. *Aphytis maculicornis* Masi (*Aphelinidae*). — A polyphagous parasite of *Diaspinae*, fairly common. It was reared from *Parlatoria oleae* Colv. (in April and May) on olive, apple, pear and rose, from *Lepidosaphes ulmi* L. on grape vine, from *Diaspis echinocacti* Bouché on *Opuntia*, in the environs of Cairo and in the Delta. Our records go from December to April.

Novicky identified some material as *Aphytis maculicornis* ssp. *aegyptiaca* nov. (in litt.) but I do not think that this form has ever been described; Novicky remarked hereto (in letter of January 1929) : "The colour is more vivid than in ssp. *hispanica* Merc. from which it differs in the fore wing being broader." The specimens seen by Novicky were collected from *Aspidiotus cyanophylli* Sign. (Giza, January, on *Alternanthera*), and *Diaspis echinocacti* B. (Hawaber, March, on *Opuntia*).

I presume that all the material of this species would belong to this particular Egyptian subspecies.

9. *Aphytis mytilaspidis* Le Bar (*Aphelinidae*). — A common species, polyphagous. — It was bred from *Aonidiella aurantii* Mask. (on *Citrus*),

Aspidiotus cyanophylli Sign. (on *Alternanthera*), *Diaspidiotus lataniae* Sign. [= *cydoniae* Comst.] (on *Psidium guajava* L.), *Aspidiotus hederae* Vall. (on Jasmine), *Asterolecanium pustulans* Cock. (on *Ficus carica*), *Chionaspis striata* Newst. (on *Cupressus* and *Thuja*), *Diaspis echinocacti* Bouché (on *Opuntia vulgaris*), *Lepidosaphes conchiformis* Gmel. [= *ficus* Sign.] (on *Ficus carica*), *Lepidosaphes pinnaeformis* Bouché (on *Citrus*), *Lepidosaphes ulmi* L. (on *Vitis vinifera* and *Populus* spec.), and *Parlatoria oleae* Colv. (on apricot).

One record, from *Ceroplastes rusci* L. (on fig), I consider doubtful. Specimens were bred practically all the year round, and all over the Nile Delta in Fayoum, and in the Nile valley south to Minia.

10. *Aspidiotiphagus citrinus* Craw. (*Aphelinidae*). — A very common and useful insect in the North, less numerous in the Southern Delta and in Giza Province. It may be reared all the year round but is no doubt more prevalent in autumn and winter. It was obtained from *Aspidiotus cyanophylli* Sign. (on *Alternanthera*), *Aspidiotus hederae* Vall. (on *Pittosporum*), *Chionaspis striata* Newst. (on *Cupressus*), *Chrysomphalus ficus* Ril. (on *Laurus nobilis*), and *Lepidosaphes pinnaeformis* Bouché (on *Citrus*).

11. *Aspidiotiphagus lounsburyi* Berl. and Paoli (*Aphelinidae*). — More abundant than the former, particularly in the coastal regions, but only locally found in the more southern parts of the country. Time of appearance as in the former species. *A. lounsburyi* was bred from the following Coccids :

Aspidiotus cyanophylli Sign. (from *Laurus nobilis*), *Aspidiotus hederae* Vall. (on *Oleander*, *Pittosporum* and *Duranta plumieri*), *Chionaspis striata* Newst. (on *Cupressus* and *Thuja*), *Chrysomphalus ficus* Ril. (on *Citrus*, Date Palm and *Laurus nobilis*), *Chrysomphalus (Mycetaspis) personatus* Comst. (on *Mangifera indica*), *Diaspidiotus lataniae* Sign. (on Oleander), *Diaspis echinocacti* B. (on *Opuntia*), *Fiorinia fioriniae* Targ. (on *Laurus nobilis*), *Lepidosaphes pinnaeformis* B. (on *Citrus*) and *Parlatoria proteus*.

12. *Azotus chionaspidis* How. (*Aphelinidae*). — Bred once in both sexes, 16.IV.1933, from *Chionaspis stanotophri* Cooley (on Halfa grass), taken at Helwân.

Identified by Dr. Ferrière.

13. *Baeoanusia oleae* Silv. (*Encyrtidae*). — Once only, from *Saissetia oleae* Bern., taken at Alexandria, on 3.VII.1930.

14. *Blastothrix erythrostethus* Walk. (*Encyrtidae*). — Was collected once from *Ceroplastes africanus* Green (on *Acacia arabica* var *nilotica*), at Wadi Kom, Asswân, 3.IV.1929.

15. *Bothriophryne* spec. (*Encyrtidae*). — From mixed material of *Cero-*

plastes rusci L. and *Asterolecanium pustulans* Cock. (on *Ficus carica*), at Derine, Talkha, on 26.IX.1929.

16. *Bothriophryne tenuicornis* Merc. [= *Trichomasthus tenuicornis* Merc.] (*Encyrtidae*). — Ref.: Mercet, Bull. Soc. Roy. Ent. d'Egypte, IX, 1925, p. 49, and Compere, Bull. Ent. Res. XXX, 1939, p. 21.

This species is known from *Ceroplastes africanus* Gr. (on *Albizzia lebbek*), collected by Alfieri at Beni Souef, on 25.IX.1921. It was not seen since.

17. *Coccophagus lunulatus* How. (*Aphelinidae*). — A regular parasite of *Lecanium* (*Coccus*) *hesperidum* L., bred from material of Sycamore (*Ficus sycomorus*), and *Citrus* (Shebîn-el-Qanater, Cairo, Meadi), emerged in September.

18. *Coccophagus scutellaris* Dalm. (*Aphelinidae*). — From *Lecanium hesperidum* L. (on *Citrus*) at Alexandria, June, and from *Pulvinaria floccifera* Westw. (on *Ficus* spec.) at Alexandria, January (coll. Alfieri).

19. *Diversinervus elegans* Silv. (*Encyrtidae*). — Distributed all over the Delta, and repeatedly bred from *Saissetia oleae* Bern. (on *Psidium guajava*, *Cycas revoluta*), *Pulvinaria floccifera* Westw. (host ?), and *Lecanium hesperidum* L. (on *Citrus*), in March, June, July, October and December

20. *Encyrtus infelix* Embl. (*Encyrtidae*). — Both sexes in numbers ex *Saissetia hemisphaerica* Targ. (on *Cycas revoluta*), at Alexandria, in January.

21. *Enargopelta nigra* Merc. (*Pteromalidae*). — From *Lecaniodiaspis africana* Newst. (on *Psidium guajava*), from Luxor (Upper Egypt), in April and May.

22. *Enargopelta* spec. (*Pteromalidae*). — Ex *Asterolecanium pustulans* Cock. (on *Ficus carica*) from Mehalla-el-Kobra and Sohâg, in April, October and November..

23. *Euaphycus flavus* (How.) (*Encyrtidae*). — A common parasite of soft scales. Reared from *Lecanium hesperidum* L. (on *Citrus*), *Pulvinaria floccifera* Westw. (on *Psidium guajava*), and *Saissetia oleae* Bern. (on *Cycas revoluta*).

All over the Delta, in Upper Egypt found at Wasta; taken in March and April and again from July to October.

24. *Encarsia elegans* Masi (*Aphelinidae*). — Bred from *Aleurolobus niloticus* Priesner and Hosny (on *Zizyphus spina-christi*), on 5.III.1932, Assiout.

25. *Encarsia indifferentis* Merc. (*Aphelinidae*) [Ref.: Bull. Soc. Roy. Ent. d'Egypte, 1930, p. 220]. — Ex *Chionaspis striata* Newst. (on *Cupressus*), leg. Alfieri.

26. *Encarsia partenopea* Masi (*Aphelinidae*). — In the autumn a common parasite of the Aleurodid *Siphoninus granati* Priesner and Hosny (on *Punica granatum*), but also bred from an Aleurodid on cotton leaves (probably *Bemisia gossypiperda* Misra and Lamba); Cairo, Meadi, Fayoum, Sohâg.

27. *Eretmocerus corni* Hald. (*Aphelinidae*). — From an Aleurodid on cotton leaves, most probably *Bemisia gossypiperda* Misra and Lamba, in August, at Sohâg and Girga.

The three following species are parasites of Coccinellids feeding on Coccidae:

28. *Homalotylus flaminius* Dalm. (*Encyrtidae*). -- Was taken from mandarine trees, attacked by *Lepidosaphes pinnaeformis* B., on 10.VII 1929, at Alexandria (host unknown), in August 1939 a male was bred from pupa of *Scymnus interruptus* Goeze.

29. *Homalotylus quaylei* Timb. (*Encyrtidae*). — In Cairo and Heliopolis (June and July), ex larvae of *Pharoscymnus varius* Kirsch (*Coccinellidae*). and probably also ex *Oxynychus marmottani* Fairm.

30. *Homalotylus vicinus* Silv. (*Encyrtidae*). — From material of *Phenacoccus hirsutus* (on grape vine), ex *Scymnus* spec. or *Oxynychus marmottani* Fairm.; Giza, VIII.

31. *Leptomastix flavus* Mercet (*Encyrtidae*). — Identified by Mercet, taken from *Pseudococcus filamentosus* Cock. (on *Albizzia lebbek*), VII.1926, leg. Alfieri (Ref.: Bull. Soc. Roy. Ent. d'Egypte, 1925, p. 46).

32. *Leptomastix phenacocci* Comp. (*Encyrtidae*). — Introduced by the Entomological Section, Ministry of Agriculture (Cairo), with material of *Phenacoccus hirsutus* from Buitenzorg, Java. Now established in Egypt.

33. *Marietta exitiosa* Comp. (?), det. Ferrière (*Aphelinidae*). — One specimen only so far, emerged 17.XI.1929, from material of twigs of *Ficus carica* from Kafr-el-Shekh, with *Asterolecanium pustulans*.

34. *Marietta* spec. (*Aphelinidae*), det. Ferrière. — From material of grape vine twigs, with *Lepidosaphes ulmi* L from Menouf, 30.XII.1929 (*Physcus* spec. was also reared from this material).

35. *Metaphycus zebratus* Merc. (*Encyrtidae*). — Both sexes ex *Saissetia oleae* Bern. (on *Ficus carica*), Barrage Experiment Farm, and Mansurah, September till December 1933.

36. *Perissopterus* spec. (*Aphelinidae*) [ex *Diaspis echinocacti* B.] (on *Opuntia vulgaris*) from Hawaber (Daqahliya), in March, and *Lepidosaphes*

ulmi L. (on *Vitis vinifera*) from Mansura, Heliopolis and Beni-Souef, December to February. — Hyperparasite.

37. *Perissopterus zebratus* Merc. (*Aphelinidae*), det. Ferrière. — Bred from material containing *Parlatoria oleae* Colv. (on twigs of *Prunus armeniaca*, and *Oleander* leaves) from Kafr Dawâr and Qena, respectively, all in April. Also from *Ceroplastes africanus* material (on *Acacia arabica* var. *nilotica*) from Asswân, in April. — Hyperparasite.

38. *Physcus testaceus* Masi (*Aphelinidae*). — A very common and no doubt useful parasite. Only found on one species of *Coccidae* : *Lepidosaphes ulmi* L. (on grape vine and poplar), emerging all the year round, all over the Delta, and south to Beni-Souef.

39. *Prospaltella berlesei* How. (*Aphelinidae*). — The well known parasite of *Aulacaspis pentagona* Targ.; it is not very widely distributed but confined — as it seems — to the northern coastal region.

40. *Prospaltella* spec. (det. Ferrière). — Bred from an Aleurodid (on rose), 28th September, 1930, Cairo.

41. *Protyndarichus coccidiphagus* Merc. (*Encyrtidae*). — Probably all over the Lower and at least the northern Upper Egypt. Bred from *Lecanium hesperidum* L. (on *Citrus* ?), *Saissetia nigra* Nietn. (on *Ficus carica*), and *Lecaniodiaspis africana* Gr.; all emerged during October-November.

42. *Scutellista cyanea* Motsch. (*Pteromalidae*). — A common species, reared from *Ceroplastes africanus* Gr. (on *Acacia* var. *nilotica*, *Albizzia lebbek*, *Ficus carica*, and *Tamarix*), *Ceroplastes rusci* L. (on *Ficus carica*), *Saissetia nigra* Nietn. (on *Ficus sycomorus*), *Saissetia oleae* Bern. (on a Composite), *Saissetia hemisphaerica* Targ.. In the Nile Delta (Gharbîya), and the whole of Upper Egypt up to Asswân, from August till March.

II. Diptera

Two species of *Cecidomyidae* were reared from Coccidae, viz.: One from red larvae feeding on *Diaspis echinocacti* B. (on *Opuntia vulgaris*); this Cecidomyid is not rare at heavy infestations of the scale insect. A second species (or the same ?) was bred from larvae feeding on *Lepidosaphes ulmi* L. (on *Vitis vinifera*) in Cairo.

Hall mentioned a *Diplosis* spec. as attacking the mealy bug *Phenacoccus hirsutus* Gr.

III. Neuroptera

1. *Chrysopa vulgaris aegyptiaca* Nav. — Larva very common everywhere, polyphagous, and sucking out all sorts of insects; among the Coccidae,

Chrysomphalus ficus Ril., *Icerya aegyptiaca* Dgl., *Phenacoccus hirsutus* Gr. and *Pseudococcus filamentosus* Cock. were observed attacked by the larvae of this Neuropteron.

2. *Nefasitus fallax* Nav. — This name was given by Navas to our small Hemerobiid which was a common enemy of *Phenacoccus hirsutus* Gr., and other mealy bugs when they were more abundant as they are at present; with the marked decrease of the host, this little Neuropteron naturally has become much more scarce in recent years.

3. *Coniopterygidae*. — A good collection of this group is under study by the well known specialist Bo Tjeder; thus it is expected that the whole group will be studied more closely and results published separately. For the moment I can only state that according to Navas (Bull. Soc. Roy. Ent. d'Egypte, 1926, p. 209), *Conwentzia psociformis* Curt. and *C. pineticola* End. are of the more common species, feeding on scale insects, particularly on *Chrysomphalus ficus* Ril. (on *Citrus*); Hall mentioned the former as a predator of *Phenacoccus hirsutus* Gr.

The genus *Coniopteryx* Curt. is represented in Egypt by *several species* of which only one has been described hitherto, viz.:

Coniopteryx aegyptiaca Withycombe (Bull. Soc. Roy. Ent. d'Egypte, 1923, p. 146). Another genus — less common, represented by at least two species — is *Parasemidalis* End., of which *Parasemidalis pallida* With. (l.c., p. 141) is introduced into science.

Navas records (l.c.) *Semidalis curtisiana* End. as another Egyptian form, inhabiting the desert valleys south-east of Cairo.

IV. Coleoptera

A. Coccinellidae

1. *Chilocorus bipustulatus* L. — Is a general feeder on scale insects, of no great importance. It was taken from materials of *Chrysomphalus ficus*, and actually seen feeding on this scale insect, and it was also taken from *Lepidosaphes pinnaeformis* B. and *Asterolecanium bambusae* Boisd. (the latter according to Willcocks, A survey of the more important economic insects and mites of Egypt, 1922, p. 336).

2. *Exochomus flavipes* Thunbg. spp. *nigripennis* Er. — Usually feeding on Aphids and mealy bugs but also attacking *Chrysomphalus ficus*. This species is not rare, and, according to Moh. Kamâl, its economic importance is considerable.

3. *Pharoscymnus varius* Kirsch. (Ref.: Priesner, Min. Agric., Techn. Bull. 117, p. 18). — Of little importance, particularly fond of *Chrysomphalus ficus* Ril.

The beetle begins the attack of a scale insect usually at the side of the hard scale cover, cutting out a triangular portion whence it reaches the soft body of the insect. The larva is wholly black, and is comparatively short and stout, covered with long, fine hairs; pupa pale brownish, densely covered as well with rather long, erect, fine hairs. The beetle was also observed feeding on *Chionaspis striata* Newst. (on *Thuja*).

4. *Pharoscymnus sexguttatus* Gyllh. — Beside this, there are a few other species existing in Egypt, none of them of importance, we do not even know their hosts with certainty.

5. *Scymnus (Pullus) syriacus* Mars. — An enemy of *Phenacoccus hirsutus* Gr., *Pseudococcus filamentosus* Cock., and *Pseudococcus citri* Risso, particularly devouring the egg-masses, and no doubt feeding on other mealy bugs too. Willcocks thinks it may also feed on young stages of *Chrysomphalus ficus*. This species is common, and — as all other *Scymnus* — of importance in the control of mealy bugs; they would be an excellent help against Coccids, if they were not parasitized by *Homalotylus* spp. and probably other *Chalcidoidea*.

6. *Scymnus (Pullus) pallidivestis* Muls. — Feeds on egg-masses of *Phenacoccus hirsutus* Gr. and *Pseudococcus filamentosus*, and other species of the latter genus, as the former (No. 5) does; it also attacks the Aleurodid *Siphoninus granati* Priesner and Hosny (on pomegranate); it is common on sugar cane too, and has most likely to do with *Pseudococcus sacchari* Cock. It is a very common and useful insect.

7. *Scymnus interruptus* Goeze. — One of the most common species of the genus *Scymnus* in Egypt; though it is usually found in connection with Aphid attacks, it is also very fond of mealy bugs; it is the same species as is reported by Adair, Willcocks and Hall under the name of *Scymnus biverrucatus* Panz.

Hall mentions it as enemy of *Phenacoccus hirsutus* but it is certainly not confined to this mealy bug only. It is parasitized by *Homalotylus flaminius* Dalm.

8. *Scymnus includens* Kirsch. — Was seen feeding on *Pseudococcus citri* Ri., *Chrysomphalus ficus* Ril., and *Pinnaspis zillae* Hall, but is much less common than the former and only of limited and local importance.

9. *Scymnus (Nephus) kiesenwetteri* Muls. — Rather common but of little use, as it is generally found on *Tamarix*, associated with *Naiacoccus serpentinus* var. *minor* Green.

10. *Scymnus (Nephus) tamaricis* Capra. — In Upper Egypt on *Tamarix*

(ex coll. Alfieri), probably replacing *Scymnus kiesenwetteri* Muls. -- Host presumably the same.

11. *Scymnus (Nephus) bipunctatus* Kug. — Was found at the Delta Barrage, on *Chenopodium* spec., feeding on *Pseudococcus* spec. (ex coll. Alfieri).

12. *Oxynychus marmottani* Fairm. — Attacking *Phenacoccus hirsutus*, *Pseudococcus filamentosus*, and other *Pseudococcus* spp. — Not rare but unfortunately checked by *Homalotylus* spp.

13. *Vedalia (Rodolia) cardinalis* Muls. — The well known predator of *Icerya purchasi*, was originally introduced, and has been well established for years.

Preying on *Icerya aegyptiaca*, and — according to Moh. Kamâl — on *Pulvinaria* spp. too.

14. *Novius rufipennis* Pic. — Enemy of *Pseudaspidoproctus hyphaeniacus* (Hall), on the Doum Palm (*Hyphaene thebaica*) in the oasis Kharga and perhaps elsewhere in Upper Egypt. The beetles emerge from the red larvae as early as in April. — No economic importance.

B. Nitidulidae

1. *Cybocephalus flaviceps* Reitt. — Common, both larvae and adults feeding on *Chrysomphalus ficus* Rd. (on *Citrus*), *Diaspis echinocacti* B. (on *Opuntia vulgaris*), *Lepidosaphes ulmi* L. (on *Vitis vinifera*), *Pinnaspis zillae* Hall (on *Calotropis procera* and *Zilla spinosa*).

2. *Cybocephalus* spp. and *Dissia* spp. are under study.

V. Lepidoptera

1. *Autoba beraudi* Joannis. — Feeds on egg-masses of *Phenacoccus hirsutus* Green.

2. *Autoba gayneri* Rothsch. — Is reported feeding on *Phenacoccus hirsutus* Gr., and also *Asterolecanium pustulans* Cock. may, after Adair, be one of the hosts.

3. *Autoba teilhardi* Joannis. — Was not yet seen feeding on Coccidae but has very likely similar habits as the two preceding species.

4. *Coccidiphaga scitula* Ramb. — Reared from *Ceroplastes africanus* Gr. (on *Tamarix* and other plants), *Lecaniodiaspis africana* Newst. (on *Ficus carica*), and *Lecanium longulum* Dgl. (on *Acacia nilotica* and *Albizzia lebbek*). — Common.

5. *Rivula sericealis* Scop. — According to Hall, this species feeds on *Phenacoccus hirsutus* Gr.

6. *Stathmopoda auriferella* Mayr. — Was bred from material of *Phenacoccus hirsutus* but this record was not confirmed later.

VI. Thysanoptera

1. *Karnyothrips flavipes* (Jones) [=*longisetis* Bagn.]. — Adults and larvae prey on *Asterolecanium pustulans* Cock. (on *Ficus carica*), *Saissetia oleae* Bern. (on *Psidium guajava*), *Lepidosaphes pinnaeformis* B. (on *Citrus*), *Lepidosaphes ulmi* L. (on *Vitis*), *Aonidiella inopinata* Leon., *Parlatoria oleae* Colv. (on apple), *Fiorinia fioriniae* Targ. (on *Laurus nobilis*), and *Aspidiotus hederae* Vall. — Common.

2. *Karnyothrips melaleucus* (Bagn.) [Ref.: Bull. Soc. Roy. Ent. d'Egypte, 1931, p. 274]. — Only once found — by Alfieri — on bamboo infested with *Asterolecanium bambusae* Boisd.

3. *Haplothrips cahirensis* (Tryb.). — Common on trees and shrubs, feeds on eggs and larvae of scale insects, particularly *Diaspinae*, as e.g.: *Chrysomphalus ficus* Ril., *Coccomytilus halli* Green, *Asterolecanium pustulans* Cock., *Pulvinaria floccifera* Westw.

4. *Podothrips aegyptiacus* Pries. — Common under leaf-sheaths of *Phragmites communis*, adults and larvae feeding on *Ripersia phragmitis* Hall.

B. List of hosts

I. Coccidae

Aonidiella aurantii Mask.: *Aphytis chrysomphali* Merc.. *Aphytis mytilaspidis* Le Bar.

Aonidiella inopinata Leon.: *Karnyothrips flavipes* (Jones).

Aspidiotus cyanophylli Sign.: *Aphytis maculicornis aegyptiaca* Nov., *Aphytis mytilaspidis* Le Bar, *Aspidiotiphagus citrinus* Craw., *Aspidiotiphagus lounsburyi* Berl. and Paoli.

Aspidiotus hederae Vall.: *Aphytis mytilaspidis* Le Bar, *Aspidiotiphagus citrinus* How., *Aspidiotiphagus lounsburyi* Berl. and Paoli, *Karnyothrips flavipes* Jones.

Asterolecanium bambusae Boisd.: *Chilocorus bipustulatus* L., *Karnyothrips melaleucus* (Bagn.).

Asterolecanium pustulans Cock.: *Aphytis mytilaspidis* Le Bar, *Enargopelta*

spec., *Haplothrips cahirensis* Tryb., *Karnyothrips flavipes* Jon., *Marietta exitiosa* Comp. (?), *Autoba gayneri* Rotsch. (?).

Aulacaspis pentagona Targ. : *Prospaltella berlesei* How.

Ceroplastes africanus Green : *Anicetus africanus* Gir., *Blastothrix erythrostethus* Walk., *Bothriophryne tenuicornis* Merc., *Coccidiphaga scitula* Ramb., *Perissopterus zebratus* Merc., *Scutellista cyanea* Mot.

Ceroplastes rusci L. : *Aphytis mytilaspidis* Le Bar, *Bothriophyne* spec., *Scutellista cyanea* Motsch.

Chionaspis stanotophri Cooley : *Azotus chionaspidis* How.

Chionaspis striata Newst. : *Aphytis mytilaspidis* Le Bar, *Aspidiotiphagus citrinus* How., *Aspidiotiphagus lounsburyi* Berl. and Paoli, *Encarsia indifferentis* Merc.

Chrysomphalus ficus Ril. : *Aphytis chrysomphali* Merc., *Aspidiotiphagus citrinus* Craw., *Aspidiotiphagus lounsburyi* Berl. and Paoli, *Chilocorus bipustulatus* L., *Chrysopa vulgaris* ssp. *aegyptiaca* Nav., *Coniopterygidae* spp., *Cybocephalus flaviceps* Reitt., *Exochomus flavipes* ssp. *nigripennis* Er., *Haplothrips cahirensis* Tryb., *Pharoscymnus varius* Kirsch, *Scymnus includens* Kirsch, *Vedalia* (*Rodolia*) *cardinalis* Muls.

Chrysomphalus (*Mycetaspis*) *personatus* Comst. : *Aphytis chrysomphali* Merc., *Aspidiotiphagus lounsburyi* Berl. and Paoli.

Coccomytilus halli Green : *Haplothrips cahirensis* Tryb.

Diaspidiotus lataniae Sign. (= *cydoniae* Comst.) : *Aphytis mytilaspidis* Le Bar.

Diaspis echinocacti Bouché : *Aphytis maculicornis* ssp. *aegyptiaca* Nov., *Aphytis mytilaspidis* Le Bar, *Aspidiotiphagus lounsburyi* Berl. and Paoli, *Cybocephalus flaviceps* Reitt., *Perissopterus* spec.

Fiorinia fioriniae Targ. : *Aspidiotiphagus lounsburyi* Berl. and Paoli, *Karnyothrips flavipes* Jones.

Icerya purchasi Mask. : *Vedalia* (*Rodolia*) *cardinalis* Muls.

Icerya aegyptiaca Dougl. : *Vedalia* (*Rodolia*) *cardinalis* Muls.

Lecaniodiaspis africana Newst. : *Coccidiphaga scitula* Ramb., *Enargopelta nigra* Merc., *Protyndarichus coccidiphagus* Merc., *Scutellista cyanea* Motsch.

Lecanium (*Coccus*) *hesperidum* L. : *Coccophagus lunulatus* How., *Coccophagus scutellaris* Dalm., *Diversinervus elegans* Silv., *Euaphycus flavus* How., *Protyndarichus coccidiphagus* Merc.

Lecanium (Coccus) longulum Dougl.: *Anicetus italicus* Masi, *Coccidiphaga scitula* Ramb.

Lepidosaphes conchiformis Gmel. (=*ficus* Sign.): *Aphytis mytilaspidis* Le Bar.

Lepidosaphes pinnaeformis Bouché: *Aphytis mytilaspidis* Le Bar, *Aspidiotiphagus citrinus* Craw., *Chilocorus bipustulatus* L., *Karnyothrips flavipes* Jones.

Lepidosaphes ulmi L.: *Aphytis maculicornis* Masi, *Aphytis mytilaspidis* Le Bar, *Cybocephalus flaviceps* Reitt., *Karnyothrips flavipes* Jon., *Marietta* spec., *Perissopterus* spec., *Physcus testaceus* Masi.

Leucaspis riccae Targ.: *Cybocephalus* spec.

Naiacoccus serpentinus var. *minor* Green: *Scymnus (Nephus) kiesenwetteri* Muls., *Scymnus (Nephus) tamaricis* Capra.

Parlatoria oleae Colv.: *Aphytis chrysomphali* Merc.(?), *Aphytis diaspidis* How., *Aphytis maculicornis* Masi, *Aphytis mytilaspidis* Le Bar, *Karnyothrips flavipes* Jon., *Perissopterus zebratus* Merc.

Parlatoria proteus Curt.: *Aspidiotiphagus lounsburyi* Berl. and Paoli.

Phenacoccus hirsutus Green: *Anagyrus pseudococci* Gir., *Autoba beraudi* Joannis, *Autoba gayneri* Rothsch., *Chrysopa vulgaris* var. *aegyptiaca* Nav., *Coniopterygidae* spp., *Diplosis* spec., *Leptomastix phenacocci* Comp., *Nefasitus fallax* Nav., *Rivula sericealis* Scop., *Vedalia (Rodolia) cardinalis* Muls., *Scymnus interruptus* Goeze, *Scymnus (Pullus) pallidivestis* Muls., *Scymnus (Pullus) syriacus* Mars., *Stathmopoda auriferella* Mayr.

Pinnaspis zillae Hall: *Cybocephalus flaviceps* Reitt., *Scymnus includens* Kirsch.

Pseudaonidia glandulosa Newst.: *Karnyothrips flavipes* Jones.

Pseudaspidoproctus hyphaeniacus Hall: *Novius rufipennis* Pic.

Pseudococcus citri Risso: *Oxynychys marmottani* Fairm., *Scymnus includens* Kirsch, *Scymnus (Pullus) syriacus* Mars.

Pseudococcus filamentosus Cock.: *Leptomastix flavus* Merc., *Oxynychus marmottani* Fairm., *Scymnus (Pullus) pallidivestis* Muls., *Scymnus (Pullus) syriacus* Mars.

Pseudococcus sacchari Cock.: *Exochomus flavipes* Thbg. var. (introduced from South Africa); *Scymnus (Pullus) pallidivestis* Muls.

Pulvinaria floccifera Westw.: *Coccophagus scutellaris* Dalm., ***Diversinervus elegans*** Silv., *Euaphycus flavus* How., ***Haplothrips cahirensis*** Tryb., *Vedalia (Rodolia) cardinalis* Muls.

Ripersia phragmitis Hall: *Podothrips aegyptiacus* Priesner.

Saissetia hemisphaerica Targ.: *Encyrtus infelix* Embl., ***Scutellista cyanea*** Motsch.

Saissetia nigra Nietn.: *Protyndarichus coccidiphagus* Merc., *Scutellista cyanea* Motsch.

Saissetia oleae Bern.: *Baeoanusia oleae* Silv., *Diversinervus elegans* Silv., *Euaphycus flavus* How., *Karnyothrips flavipes* Jon., *Metaphycus zebratus* Merc., *Scutellista cyanea* Motsch.

II. Aleurodidae

Aleurolobus niloticus Priesner and Hosny: *Encarsia elegans* Masi.

Bemisia gossypiperda Misra and Lamba: *Encarsia partenopea* Masi, *Eretmocerus corni* Hald.

Siphoninus granati Priesner and Hosny: *Encarsia partenopea* Masi, *Scymnus (Pullus) pallidivestis* Muls.

Séance du 2 Octobre 1940

Présidence de Monsieur le Professeur MAHMOUD TEWFIK HIFNAOUI Bey,
Président.

On some Egyptian Diapriidae

[Hymenoptera : Proctotrupoidea]

by Prof. Dr. H. PRIESNER

Genus **Trichopria** Ashm.

Key to Egyptian Species

1(10) Macropterous.

2(9) Antennal club distinctly three-jointed.

3(6) Antennae and legs with at least clubs of scape, femora and tibiae dark. Small species.

4(5) Two small elongate scutellar foveae. Antennal joints 5-7 globular. Wings narrower, fringe short .... 1. *aegyptiaca* spec. nov.

5(4) One transverse fovea. Antennal joints 5-7 elongate. Wings broader, fringe long. .... 2. *cheopis* spec. nov.

6(3) Legs and antennae pale fulvous or yellow.

7(8) Larger and broader. Head broad, transverse. Scutellum with one fovea. .... 3. *hannai* spec. nov.

8(7) Smaller and slenderer. Head longer than broad, narrowed posteriorly. Scutellum with two very small united foveolae. .... 4. *delicatula* spec. nov.

9(2) Antennal club four-jointed, or antennae gradually thickened.

10(11) Two small foveae at base of scutellum. Thorax depressed. Antennal club distinctly four-jointed ; scape with apical margin sharpened

within, forming a tooth-like projection. Abdomen elongate, abruptly narrowed before apex .... 5. *masrensis* spec. nov.

11(10) A shallow transversely horse-shoe-shaped fovea at base of scutellum. Thorax convex. Antennae gradually enlarged towards tip, club indistinctly five-jointed, the joints not closely united, nearly pedicellate. Head strongly narrowed posteriorly. Larger species .... 6. *helouanensis* spec. nov.

12(1) Brachypterous. — Wings reaching but first third of abdomen. Antennae and legs yellowish, club indistinctly separated. Head large. Thorax reddish, head and abdomen dark .... cf. *Phaenopria alexandrina* spec. nov.

1. Trichopria aegyptiaca spec. nov.

A comparatively small species.

Female: Black, shining, practically without punctuation, antennal scape (except base or basal half which is yellow to reddish) and club black, joints 2-9 more or less dark yellowish-brown, in some cases more yellowish-brown, in some cases more yellowish-grey. Legs brownish, trochanters, the slender portion of the tibiae, and the tarsal joints 1-4 testaceous; coxae dark, paler at tips, sometimes wholly testaceous. Pubescence of pronotum, propodeum and petiolus whitish-grey. Wings hyaline, marginal vein testaceous.

Head nearly globular, distinctly somewhat broader than long, temples (viewed from above) much longer than eyes, distinctly narrowed posteriorly; head somewhat broader than thorax, antennal projection comparatively little developed; eyes little protruding, practically smooth; temples somewhat tomentose. Antennae length 0.78 mm.; scape thin at base, gradually much thickened, apical half somewhat compressed, as long as joints 2-5 united (1); flagellum slender; joint 2 oval, much thicker and somewhat longer than 3; joints 4-9 little differing in shape from one another; *club sharply separated, three-jointed*, joint 10 distinctly shorter than 11, somewhat narrower. 12

(1) Superficial calculation of the comparative measurements may lead to considerable errors, thus descriptions ought to be always accompanied by absolute measurements. The objection that absolute measurements are misleading since insects vary greatly in size, is not correct: if we had correct absolute measurements at hand instead of the poor descriptions by the older authors, we should be able to correctly interpret most of the insects concerned, whilst because of the absence of such measurements, in most of the cases, an examination of the types is or will be necessary. If a series of specimens is at hand, it is, as to my opinion, advantageous to designate a specimen of medium size as type, and to take the measurments of the taxonomically most important parts of the body.

somewhat longer than the preceeding joint. Thorax higher than broad, normal, somewhat depressed above, with whitish tomentum in front; mesonotum separated from the scutellum, as usual, by a fine line, a little longer than broad; *scutellum with two very small, anteriorly converging longitudinal foveae* which are connected by a very shallow impression, and is sometimes visible only if viewed from a certain angle; scutellum somewhat convex posteriorly. Wings rather narrow, far surpassing apex of abdomen, distinctly fringed, the pale costa not reaching basal third of wing, marginalis thickened, basalis not even indicated. Median keel moderately developed at base of propodeum, somewhat triangularly protruding, dark. Petiolus short, transverse, with short and dense tomentum; the following abdominal segments together *elongate-ovate*, segment II occupying more than two-thirds of the length; III little longer than IV, V again longer; tip of abdomen short-triangular. Fore tibiae club-shaped, middle ones as well, slightly S-shaped. hind tibiae with club rather abrupt, about terminal third, interiorly with a series of densely set setae, exteriorly they are very sparingly set.

M e a s u r e m e n t s (in μ) : Head length, 225; head width, 282; hight, 265; eyes diameter, 78-79; antennae length, 779; lengths (breadths) of joints, 228(39), 79(36), 55(28), 43(30), 43(30), 39(32), 43(35), 39(35), 35(37), 63(57), 71(67), 98(67); joints 9-12 inclusive pedicel 45, 75, 79-83, 104; thorax length [2] 433, width 260; wings length 1020-1047 (small specimen 934), width 450-467; fringe (at apex of fore wings) 70; petiolus length (from above) 95, laterally 138; tergite II length, 433; tergites from II to apex, 528; tergite II width, 294-346; hind tibiae length 311; joints of hind tarsi length, 99, 57, 43, 39, 69-71 (without claws). — Total body length, 1.26-1.31 (small specimen 0.99) mm.

M a l e : I have only two specimens of this sex showing the *Planopria*-type of antenna. In coloration of body and legs, the male agrees with the female, and also in the shape of head and thorax. Abdomen elongate-ovate but not quite as long as in the female, segments 3-4 short, the terminal segment much narrower, rounded apically. Fringe of wings distinctly longer; wings surpassing tip of abdomen for 1/3 of their length. Foveolae of scutellum less distinctly separated, representing a single shallow fovea with a deeper, small impression on each side; if it was not for the flat thorax, I might have considered this ♂ as belonging to *Tr. cheopis*, described below.

Antennae black, shining, scape fulvous in basal half, joint 2 dusky or dark brownish; scape a little longer than the three following joints united; antenna not quite as long as the body, joint 2 oval, 3 elongate, longer, with two whirls of setae, slightly widened towards apex, 4 a little shorter, some-

[2] Inclusive propodeum.

what thickened, emarginated within (about two basal thirds), with a distinct small black spine about the apical third; joints 5-13 without long pedicel; a very short pedicel is only just recognizeable on joints 5-6-7; joints 4-13 each with 1 whirl of moderately long, dark setae; 14 irregularly set with dark setae, conical.

Measurements (dry mount) in μ: Head length, 208; width, 300; hight 277; antennal joint 2, 69, joint 3, 95, joint 4, 95, joints 5 and 6, 69, joint 12, 59; whirl hairs on joints 5 or 6, 87 long; thorax length (medianly), 433-450; thorax width 277; scutellum (total length) 156; wings length 1125; petiolus (dorsal) length 104, hind tarsi length 372; abdominal segment II, length, 476, width 286. — Total body length: 1.298 mm. (small specimen, 0.969 mm.).

This species seems to be common in Egypt; in numbers I found it in the detritus of a canal at Meadi, from March to August, and again from October to December; it obviously occurs practically all the year round; one specimen came to the light in April.

From the other Egyptian species of this genus, it is separated by the form of the scutellar foveolae combined with having the antennal club decidedly 3-jointed; moreover, there is no further species known, presenting this combination of characters; *T. musciperda* Kieff. (France), unknown to me but obviously somewhat similar as to shape of scutellar depression, is evidently a larger form (2 mm.), with thorax broader, antennal 2 equalling 3, 8 longer than broad ("wenig länglich"), mesonotum convex, petiolus more elongate, etc. On comparing the male with those described hitherto, it is thought to be near *Tr. lacustris* Kieff., but ours is a smaller form, having scape much longer, and joint 3 longer as compared with 2; *T. nigripes* Thms. which I possess from Austria (Linz and Sarleinsbach, VII-IX, leg. J. Kloiber), is much larger, has longer antennae with joints pedicelled, and with *long* whirls of setae.

2. Trichopria cheopis spec. nov.

Female: Black, clubs of femora and tibiae, and tarsal joint 5 brownish; trochanters, base of femora, slender part of tibiae, and tarsal joints 1-4 yellow to dull yellowish, sometimes petiolus and tegulae or also a spot below the latter, partly brownish. *Coxae fulvous to rufous*, at most *slightly* shaded, always lighter than tibiae and femora; antennae with basal half of scape rufous, joints 2-9 so or darker, more or less dark brownish; wings hyaline. Very small, not fully mature specimens may have thorax wholly, head and abdomen partially reddish but are recognizeable as belonging to this species not only by the form of the antennal joints but also by the red coxae, whilst clubs of femora and tibiae are much shaded, and their thin parts are yellowish.

Head broader than long, eyes scarcely prominent, head narrowed behind. temples convex; ocellar triangle not equilateral; scape compressed in basal half, thin, thicker in distal half, *flagellum very slender*, joint 2 longish oval, 3 somewhat shorter and much narrower, 4-8 gradually shorter and slightly broader, all a little longer than broad, 9 scarcely longer than broad, little but somewhat, thicker than 8; *club sharply separated, three-jointed*, joint 10 much thicker than 9, about as long as broad (or very slightly longer), 11 somewhat thicker, as long as broad, 12 distinctly longer than 11. Thorax little narrower than head, slightly convex above, tomentum of pronotum slightly developed, scutellum slightly convex, sides somewhat converging posteriorly, in front with an arched, transverse fovea which is not deep at all but more deeply impressed laterally, ground shining to slightly rugose (striolate). Wings moderately broad, reaching far beyond tip of abdomen, fringe rather long. Propodeum with a triangular lamella. Petiolus, viewed from above, as long as broad, posteriorly with somewhat longer whitish pubescence at the sides; in lateral view straight below, convex in front, above; the remaining abdomen evenly fusiformly ovate, i.e. gradually pointed towards apex, upper and lower side convex; tergite III very slightly longer than IV, V somewhat shorter than III and IV united. Hind tibiae slightly curved, club-shaped in apical third; joint 1 of hind tarsi distinctly shorter than joints 2 and 3 united.

M e a s u r e m e n t s (in μ) : Head width, 294, head hight 260-295; diameter of eyes, 104; antennae length, 900; joints (holotype, dry mount), 2 : 78. 3 : 52, 10 : 61, 11 : 69, 12 : 110; joints (microscopic mount) measured from extreme base to apex), 242-260 (39), 87 (37), 59 (26), 51 (27), 49 (26), 47 (28), 55-57 (28), 49 (30), 51 (32), 63 (51), 79 (63), 114 (63); club joints with pedicel, 75, 99 and 138; thorax length 450-535; width, 286; scutellum width about 120; wings length 1142-1160 (small specimen, 830, large one 1228-1349); length of costa + marginalis, 407; fringe length at apex of wing, 105; petiolus length, 110 (dorsal), 185 (lateral); tergite II length, 460; tergite II and following, 632-727 (smallest spec., 433); tergite II width, 295; hind tarsi length 345, joints, 110, 75, 57, 47, 73 (without claws). — Total body length : 1.436 mm. (largest specimen, 1.590; smallest one, 0.865 mm.).

M a l e : Unknown.

This species, though most similar to *T. aegyptiaca* in shape and colour, can only be compared with *T. hannai*, in having but one transversal fovea, and a sharply separated 3-jointed antennal club; from the latter it is distinguished by its smaller size, the shape of the antennal joints, particularly the comparatively larger terminal joint, moreover, by the less broad head and the darker coloration of antennae and legs; of the old palaearctic species, *musciperda* Kieff. may be taken for comparison; this species, however, apart from its differrently shaped scutellar fovea, has antennal joint 3 not shorter than 2, wings little surpassing tip of abdomen, and has coxae black; *tenui-*

cornis Thms. is said to have dark coxae and is no doubt a much larger insect.

Habitat : A series of 7 females of this insect were collected by me near the Pyramids of Gizah, on 4. VIII. 1933 and IX. 1933, from detritus of the Nile inundation ; 1 specimen (coll. Alfieri) was collected about the same locality and under the same circumstances, by Mr. A. Rabinovitch.

3. Trichopria delicatula spec. nov.

Female : Black, shining ; prothorax, pleurae, propodeum and base of abdomen reddish, petiolus (and sometimes propodeum) yellowish-red, legs inclusive coxae, clear yellow (reddish-yellow), 5th tarsal joint slightly shaded scape and flagellum yellow (reddish), the three club joints black. Costa and marginalis testaceous, tegulae reddish.

Head, seen from above, seemingly longish, about the anterior third (across eyes) broadest ; hence tapering toward base in an almost straight line ; ocellar triangle nearly equilateral. Scape curved, thin at base (compressed), well as long as the four following joints combined, 2 oval (narrow at base), about 1.5 times as long as broad (without root), 3 somewhat shorter and much thinner, elongate, 4-7 distincly longish, 8 about as long as broad, 9 a little broader. as long as broad or slightly transverse, 10 much broader than 9 but distinctly narrower than the penultimate, which is also not transverse, 12 about 1.5 times as long as 11 oval, straight exteriorly, convex interiorly. Thorax slender, elongate, somewhat narrower than the head, convex, tomentum of prothorax distinct, but not very thick, very little developed on occiput ; mesonotum. as usual, with 2 fine setae above ; scutellum convex, rounded in front, *where it has two very small punctiform foveolae which are united with each other ;* sides of scutellum slightly arched, narrowed posteriorly : keel of propodeum blunt : propodeum deeply excavated posteriorly. Wings moderately broad. long, far surpassing apex of abdomen, hyaline, with long fringe. Abdomen elongate-ovate, sides evenly convex, evenly pointed behind ; petiolus elongate, about 1.5 times as long as broad, with whitish pubescence posteriorly, which is arranged in two lateral tufts. Legs normal, hind tibiae with strong club in posterior third ; joint 1 little shorter than 2 and 3 united.

Measurements (measured from dry mount except antennal and tarsal joints), in μ : Head length (dorsal, median), 216, width 254, hight 294 ; eyes diameter 113-130 ; antennae length, 285 : joints lengths (breadths), 250 (47) 87 (39), 47 (28), 45 (28), 41 (30), 39 (32), 45 (33), 39 (34), 43 (37), 69 (61), 87 (73), 113 (73), thorax length 502, width 250 : scutellum length 138 ; wings length, 1246-1263, width 363 ; costa + marginalis, 380 ; fringe length 87 ; petiolus (dorsal) 113-121, ventral (total) 173-190 ; tergite II length, 424 ; width, 310 ; tergite II and following combined, 588 ; hind tibiae, 345-363 ; hind tarsi, 345-355 ; joints 1-5 of hind tarsi, 114, 67, 57, 45, 79. — Total body length : 1.50-1.52 mm.

Male: Unknown.

Although this species is well characterized by the shape of body and antennae, and is a true *Trichopria*, it might be looked for in the genus *Phaenopria*. With *T. bipunctata* Kieff. and related spp., *T. delicatula* cannot be confused; it does not belong in this section of species, as can be seen from the convex thorax, the slender shape, the 3-jointed antennal club, and the fusiform shape of the abdomen; in *musciperda* Kieff., the only species to which one might refer, the scutellar foveae are surely larger, and fused in front; it is moreover larger, has wings shorter, legs darker, etc.; *T. cheopis*, described above, is similar in the antennae and wings, but the shape of the thorax, the scutellar foveolae, the coloration of legs and antennae are quite different.

Habitat: I only caught two specimens of this insect, which I selected from detritus-material, collected at Gizah (4. VIII. 1933), together with the more common *T. cheopis*.

4. Trichopria hannai spec. nov.

Female: Black to piceous, shining, paler specimens have either pleurae and petiolus only, or the whole thorax dark reddish-brown, whereby also base of abdomen may be paler; antennal joints 1-9 yellow to fulvous (sometimes joint 10 too paler at base), club (10-12) dark; 5th joint of maxillary palpi shaded. Legs — inclusive coxae — yellow, last tarsal joint dark, costa and marginalis testaceous. Wings hyaline or *very* slightly yellowish.

Head heavy, as broad as the thorax, eyes not protruding, temples much narrowed posteriorly, scarcely convex, ocelli large. Scape compressed in basal half, claviform in distal half, joint 2 narrower but distinctly broader than 3, somewhat longer, its pedicel compressed, cup-shaped, 3 slightly constricted at base if viewed from a certain angle; the following joints gradually decreasing in length, 8 almost 1.5 times as long as broad, 9 longer than broad, somewhat thicker than 8; 10-12 forming a clearly separated, shining club, 11 at least in one direction distinctly broader than long, *12 scarcely longer than 11*, short, oval (almost cordiform), bluntly rounded at apex; joint 9 with a small tubercle distally, within; the apex of 11 slightly produced, exteriorly Mesonotum slightly but distinctly convex above; scutellum in its posterior part — which is slightly and evenly elevated — somewhat broader than long, laterally distinctly margined, in front with one transverse, rather deep fovea, the sides of which somewhat converge posteriorly; scutellum without keel; propodeum with keel somewhat prominent but blunt basally; occiput and prothorax with greyish tomentum, pleurae, of mesothorax polished, of propodeum, and the petiolus adpressedly, not very densely pubescent; propodeum smooth, somewhat excavated in the middle of its hind margin, on either side of the keel. Wings far surpassing apex of abdomen, marginalis terminating about basal

third, truncate apically; fringe long, its length (at hind margin about one-third of breadth of wing. Petiolus nearly as long as broad, sides straight and parallel, with fine, white pubescence behind; abdomen (from segment II) elongate-ovate, evenly fusiform, segment IV nearly but one-half of segment III, segment V somewhat longer than III. Fore tibiae club-shaped, middle-tibiae S-shaped, apical *half* claviform, hind tibiae claviform in apical third, with dense fringe of setae at inner margin, with scattered long setae exteriorly; tarsi with long setae.

Measurements : Head length (dorsal), 345-363; width, 398; hight, 346; eyes diameter, 173; diameter of front ocellus, 43; antennae length, 1055-1160; joints lengths (breadths), the later measured from microscopic mount: 311-329(59-66), 87(52), 78(39), 69(37), 66(36), 61(37), 61(40), 61(42), 55(51), 87(79), 81(91), 112(83); club joints inclusive pedicel, 102, 102, 138; thorax length, 657-709; width, 380-398; petiolus (laterally, i.e. total) 234; width, 130; tergite II, length, 588; width, 484; tergite II and following, 865; wings length, 1263; width, 580; length from base to end of marginalis, 528; fringe (at apex of wing) 120; hind tibiae, 467; hind tarsi 415; hind tarsal joint (microscop. mount), 126, 79, 67, 57, 97. — Total body length : 1.68-1 97 mm.

(Owing to circumstances, the description of the male has to be given later).

Tr. hannai belongs in the section of the genus having sharply separated 3-jointed antennal club, normally developed scutellar fovea, and — even in fully mature specimens — pale antennae (exclusive club); it is characterized by the shape of the scapus and the funiclar joints, the short ultimate club-joint, the usually, at least laterally, reddish-brown thorax, and by the fusiform abdomen; it may be compared with *ciliaris* Kieff. (sensu Maneval, Bull. Mus. Hist. Nat. Belg., XIII, p. 11, figs, 1937) (3); but this species (common in Europe) has antennal club longer, less shining, joint 9 comparatively larger, joint 3 more elongate (distinctly longer than 2), scape normal, abdomen not fusiform, etc.; beside *ciliaris*, *T. madeirae* Kieff. comes near, has however joint 11 longer than broad, 12 pointedly oval, and the abdomen is said to be rounded apically.

Habitat : Some specimens were collected by me at the light at Meadi,

(3) In my collection, there is a female example of this species, *identified* by Kieffer as *thomsoni* Kieff., a species to which Thomson as well as Kieffer refer a male that has planoprioid antennae, with a small denticle on antennal 3, and which is very similar to *Ashmeadopria verticillata* Kieff. in many other respects; this male, however, seems to belong to the female of another species which might be very difficult to separate from *A. verticillata* Kieffer (females). *Tr. verticillata* Thomson and *thomsoni* Kieffer (females) are most likely identical with *ciliaris* Maneval, and *ciliaris* Kieffer as well, provided that Maneval has actually compared with Kieffer's type.

in November, and some from the foliage of *Citrus* trees at Talbiah (Gizah). the same month; others were bred from pupae of *Drosophila* spec., by Dr. Assaad Hanna — to whom the insect is dedicated —, on rearing insects from pods of *Acacia arabica* var. *nilotica*, in the laboratory of the Entomological Section, Ministry of Agriculture, at Dokki.

5. Trichopria masrensis spec. nov.

Femalo: Black, shining, scapus and club black, joints 2-8 blackish-brown to reddish-brown; legs dark, trochanters, basal half of tibiae, and the tarsal joints 1-4 yellow or brownish-yellow; very similar in colour to *bipunctata* Kieff. to which it is closely related.

Head looking longish, eyes small, not protruding, not pilose; head with a few longer, scattered setae; ocelli close to one another; scape almost as long as the four following joints combined, slightly curved, widened toward apex, *apical margin somewhat sharpened and raised within, so that — viewed from above — it more or less protrudes (in profile) as a small, dark tooth;* this toothlet is not so well visible in small specimens as in large ones; joint 2 elongate-oval, well 1.6 times (to twice) as long as broad, *distinctly somewhat longer than 3*, which is about 1.5 times as long as broad; 4 and 5 slightly longer than broad, 6-8 globular, the latter (8) perhaps slightly transverse in one direction, little thicker than 7, so that the following 4-jointed club appears well separated; the club-joints 9-11, seen laterally, are slightly transverse, ultimate joint somewhat longer than broad, 1.5 times as long as 11, much shorter than the two preceeding joints united; tomentum on occiput scarce, on pronotum richer. Thorax little broader than the head, scutellum quadrangular, truncate posteriorly; *in front, as in bipunctata, with two separated shallow foveolae;* metathorax grey pubescent, hind angles produced into a small tooth; wings long, moderately broad (see measurements), considerably surpassing the abdomen, with but *moderately long fringe;* costa + marginalis occupying less than one-third of the wing's length; keel of propodeum, viewed laterally, only slightly raised in front. Petiolus short, somewhat broader than long, distinctly greyish pubescent in posterior half. Abdomen elongate, depressed as in *bipunctata*, slightly widened toward apex, abruptly narrowed in posterior fourth or fifth, and pointed; segment IV distinctly shorter than III. Legs *moderately* long (cf. *bipunctata*), fore tibiae club-shaped, middle tibiae slightly S-shaped, thickened in apical half, hind tibiae claviform in the two apical fifths (or more); joint 1 of hind tarsi about as long as 2 and 3 united.

Measurements (dry mount) in μ: Head length (dorsal), 260; width, 268; hight, 260; eyes diameter, 104; antennae length (max.) 952; joints lengths (breadths), 208-216(43), 69-78(38-40), 52, 43, 43(35), 42(35), 42(47),

43(61), 64(64), 67(69), 69(69), 90(61); thorax length, 433-450; width, 286; mesonotum length, 190; scutellum length, 130; wings length, 1125-1147; width, 407; length of costa + marginalis, 310; apical fringe, 87; petiolus (dorsal), 95-104; tergite II length, 450; width, 311; abdomen from segment II, 588; hind tibiae length, 330; hind tarsi length, 330; tarsal joints, 104, 61, 45, 42, 78. — Total body length : 1.384-1.557 mm.

T. masrensis is so close to *T.* (*T.*) *bipunctata* Kieff. (1911, in André, Spec. Hym. Eur., 10, p. 997; id., 1916, Tierreich, Lfg. 44, p. 86; Maneval, Bull. Mus. Hist. Nat. Belg., XIII, p. 10, figs) [4], that I had noticed the specific differences between the two species only after a close study; *masrensis* is distinguished from *bipunctata*, and perhaps all other known species which possess two scutellar foveae, by the small tooth-like projection of the apex of the scape; besides, joint 3 is shorter (than in *bipunctata*), less elongate, and the club joints are broader, the club — as a whole — better separated; the wings are narrower, and their discal setae are more closely set.

Male: Unknown.

Habitat: I found two females of *T. masrensis* in the detritus of an irrigation canal (30.V and 26.VI.1933) at Meadi; in Mr. Alfieri's collection were two further specimens, from Ikingi (Mariout), collected by Mr. A. Rabinovitch, on 10.VI.1936.

6. Trichopria helouanensis spec. nov.

Female: Black, shining, scape reddish in basal half, funicular joints red at extreme base; legs reddish to yellowish-brown (or dark yellow), with coxae, clubs of femora and tibiae, and 5th tarsal joint more or less slightly shaded; apex of abdomen sometimes brownish; wings hyaline.

Head a little broader than long, eyes large, head strongly narrowed behind them; *antennae very slender*, somewhat surpassing base of abdominal segment II; joints 3-5 appearing slightly club-shaped; scape thin in basal half (in one direction), rather gradually thickened towards apex; joints 2 and 3 about equal in length, 2 almost oval, 3 slightly concave in basal half; *joints gradually enlarged towards tip of antenna*, a club is not distinctly separated; *all joints at least slightly longer than broad*; tomentum on occiput and prothorax very well developed; thorax somewhat convex; scutellar fovea transverse, not deeply impressed, scutellum slightly convex, margined laterally, a little tapering posteriorly; propodeum deeply excavated, hind angles

(4) *T. bipunctata* is, as Maneval (l.c.) already mentioned, a very common and widely distributed species; it also occurs in Central Europe (Austria, in the Alps as well as in the Danube area, north into Bohemia), being there, as to my opinon, the most common species of the genus.

slightly pointed ; median keel triangular in front, black. Wings well surpassing the abdomen, normal, fringe moderately long. Petiolus somewhat longer than broad, with rather long erect pubescence all over, surface rugose, with fine longitudinal keel; abdomen from segment II onward fusiform, convex, segment III about twice as long as IV, and longer than V. Legs slender, *hind tibiae distinctly* curved inward (at middle of length), sparingly set with setae exteriorly, provided with a dense comb of stronger setae inside; club of tibiae occupying posterior third (or somewhat more) of them; hind tarsi shorter than tibiae, joint 1 about as long as 2 and 3 united.

Measurements (from dry mount) in μ : Head length, 346; width, 380, high, 346; diameter of eye, 190; antennae length, 1420; joints lengths (widths), 363 (52), 95 (42), 95 (29), 87 (31), 78 (35), 86 (35), 104 (43), 95 (52), 95 (69), 95 (80), 86 (80), 142 (78) ; thorax length, 709; width, 433; scutellum length, 208; wings length, 900; width, 623; length of costa + marginalis, 588; fringe (at apex of wings), 104; petiolus length, 147; width, 105; tergite II length, 606; width, 467; tergite II and following tergites 952; tergite III, 78, tergite IV, 69; hind tibiae length, 570; hind tarsi length, 519; hind tarsal joints, 146-173, 95, 78, 69, 105. — Total body length : 1.99-2.08 mm.

Male: Unknown.

This species is quite peculiar among the Egyptian congeners, by the slender, gradually thickened antennae, the slender legs and the fusiform abdomen; there is only *T. elongata* Thms. (from Europe), which may be similar; though insufficiently described, it is shown that this species has wings shorter, little surpassing the abdomen, and joints 9-12 of equal width; *helouanensis* comes also close to *T. elegans* spec. nov. (from the Vienna "Prater", leg. F. Blühweiss) which has however still more slender antennae [5] (and legs), with club much elongate, eyes somewhat protruding, hind tibiae more strongly curved, and hind tarsi longer than hind tibiae, very slender; this species will be more fully described elesewhere.

Habitat : Three specimens from the following localities : Helouan (III, C. Koch), Meadi (IX, at light, H. Priesner), Wasfija (IV, A. Rabinovitch).

[5] Measurements of antennal joints 2-12 of *T. elegans* nov. spec.: 95(39), 104(35), 110(35), 110(35), 87(35), 78(38), 70(38), 70(45), 80(53), 87(57), 81(47) μ.

Séance du 13 Novembre 1940

Présidence de Monsieur le Professeur MAHMOUD TEWFIK HIFNAOUI Bey,
Président

The morphology, anatomy and biology of *Araecerus fasciculatus* De Geer

[Coleoptera : Anthribidae]

(with 1 Text-Figure and Plates I-VIII)

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A. INTRODUCTION

Araecerus fasciculatus De Geer is an Anthribid beetle of considerable economic importance. It is supposed to be indigenous in India East Indies and the Malay States, but now its occurrence is more or less cosmopolitan, though it is more common in the tropical and subtropical countries. It was first described by De Geer (1775). Lucas (1861) recorded it boring into the branches of the Chinese ginger in France. Reh (1907) discussed its economic importance. He mentions its occurence on hard seeds, thick-skinned bulbs, palm seeds, nuts of *areca*, roots of ginger, coffee beans, nutmeg, mace, tamariscus, euphorbiaceae, cotton seeds, cacao beans, dried apples, peaches and oranges. According to him, its geographical distribution includes

India (where it is indigenous), Europe, U.S. America (Louisiana and Florida), Central America, French Guiana, Bermuda, Brazil, St. Helena, Persia. Ceylon, Java, China, Japan, Sandwich Isles and Philippine Isles.

Reh thinks that *Araecerus fasciculatus* De Geer has only one generation a year and, as well as Lucas, mentions about two weeks for the pupal period.

Tucker (1909) records its occurrence in corn-stalks in fields adjacent to cotton in Louisiana, and points out that it is found in association with the cotton boll weevil in the corn-stalks. He states that the insect is sometimes a scavenger feeding on the decayed cotton bolls.

Again, Van der Goot (1917) records it as a field pest on *Tephrosia candida* in Java and he calls it the *Tephrosia* beetle. He points out that the *Tephrosia* beetle (which was identified by European entomologists as *Araecerus fasciculatus* De Geer) does not attack stored coffee or cacao in Java although these are attacked by *Araecerus fasciculatus* De Geer in the island. It is also interesting to note that according to Van der Goot, *Tephrosia vogeli* is immune from the attacks of the *Tephrosia* beetle even if grown among seriously infested trees of *Tephrosia candida*. This shows that the beetle has developed a food preference instinct to a great extent when it is known that the attack of *Tephrosia candida* is caused by the beetles flying from wild leguminoseae, especially *Crotalaria striata*. On the other hand, *Araecerus fasciculatus* De Geer as a stored product insect is polyphagus to a great extent, feeding on all sorts of seeds and grains especially if they are not dry. It can also live to a certain extent on flour, thrives on biscuits and even the ordinary bread preferring the crumb to the crust.

Rutgers (1918) also seems to doubt the identity of the *Tephrosia* beetle, stating that *Araecerus fasciculatus* De Geer severely attacked a sample of Liberian coffee, but that either this beetle or a closely related one attacks the seeds of *Crotalaria* and *Tephrosia*.

Cotton (1921) wrote a very short description of the external appearance of the four stages of the insect. The points of difference between his description and the writer's are discussed later under different headings.

Autuori (1931) published a short external description of all the stages with a reference to the biology. His work was concerned with *Araecerus* as a pest on Brazilian coffee.

Lefroy (1909) states that *Araecerus fasciculatus* De Geer or « a very closely allied species breeds freely in old, dried cotton seeds that remain on the plant after picking ». If Lefroy's illustrations are correct, the insect concerned cannot be *Araecerus fasciculatus* De Geer. Differences between cotton seed beetle in India and *Araecerus fasciculatus* De Geer are discussed later.

Ogilvie (1925) records it on stored maize in Bermuda where it is also

found associated with the « black tip » disease of banana which causes the black discolouration of the skin of the fruit and this is subsequently attacked by the larva of *Araecerus fasciculatus* De Geer. It is recorded damaging the boll and seeds of the cotton plant in Africa (Zacher, 1913), attacking cacao in Gold Coast in the drying stages and then in the stores (Patterson, 1928), on cacao pods in Nigeria (Lamborn, 1914), in coffee berries in Dutch East Indies (Friederichs, 1925), where it attacks Brazil nuts as well (Gater, 1925), on *Areca catechu* (Papilionaceae) in India (Beeson, 1919), on monkey-pod (*Samanea saman*) in Hawai (Bridwell, 1920) and carrier of the fungus *Diplodia* in Philippines where it attacks a number of plants in storage, including roots, seeds and fruits (Sarmiento, 1923). It is interesting to note that Tucker (1908), Van der Goot (1916), Crawford (1916) and Bridwell (1919) have referred to parasites of the beetle. One of the parasites referred to is a mite belonging to the genus *Pediculoides* and most of the rest are Hymenopterous, two being Braconids (and according to Van der Goot, these are not yet identified). There is no reference as to the possibility of controlling the insect by any of the above parasites. The pest is certainly more important in stored products than in the field, and hence controlling it by the use of parasites is not likely to be effective, except in a place like Gold Coast where the infestation originates in the field.

Araecerus fasciculatus De Geer was first recorded as a British insect in 1831 by Stephens in London, Suffolk and Devonshire under the name *Phloeobius griseus* Fab.; it was recorded by him again in 1839.

Shuckard and Spry (1840) recorded it and stated that it was imported. Crotch (1866) in his « Catalogue of British Coleoptera » records it under « accidently introduced species ». Bold (1872) records *Phloeobius griseus* Fabr. from Sunderland. Fowler (1891) states that « the single species of *Araecerus* which is found on the Continent is evidently an importation ». Newbery (1902) records the occurrence of *Tropideres* (*Enedreytes*) *hilaris* Fahrs., in a London Warehouse. According to Day (1908) — who records *Araecerus* in a biscuit factory in Carlisle — Newbery was under a misapprehension in 1902 as he admitted later that what he had described as *Tropideres hilaris* Fahrs. was really *Araecerus fasciculatus* De Geer.

It has been recorded by Munro and Thompson (1929) in London docks on consignments of nutmeg from Grenada and East Indies; also in West African and Panama cacao, and occasionally, in cacao from Venezuela, Ecuador, and Ceylon. They remark that the insect « although abundant in Grenada nutmegs, occured in only one of about a dozen consignments of Grenada cacao examined ». Cotterell (1934) refers to its economic importance as a stored cocoa pest in Gold Coast. It has been observed in Egypt in imported nutmeg.

There are several more references indicating the geographical distribution of the insect and the infestation of a great variety of foods.

The writer worked the biology of *Araecerus fasciculatus* De Geer with special reference to the effects of variations in the nature and water content of the food. This work has been published in the Annals of Applied Biology, London, 1935.

B. ACKNOWLEDGMENTS

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C. MORPHOLOGY OF THE ADULT

The length of the adult (Fig. 1, and Plate I, fig. 1) ranges from 2.7 to 5.3 mm.; while the breath ranges from 1.7 to 2.1 mm.; the minimum measurements appearing only in very rare cases.

The colour is dark brown in mature individuals and lighter when newly emerged. The colour is not uniform on the head, prothorax and elytra, owing to the distribution of bristles and to the presence of dark and white patches on the elytra and to less extent on the prothorax. The sternites are uniformly dark brown and clothed with whitish bristles except on the anterior part of the mesosternum. The thoracic and abdominal terga are almost pale amber in colour except the meta-tergal ridges and the meso-scutellum which are more heavily chitinised. The pro-pygidium and pygidium are highly chitinised.

1. The Head

As in other Rhynchophora, the elements constituting the head of *Araecerus fasciculatus* De Geer are completely fused (Plate I, figs. 2, 3 and 4). The head is heavily chitinised with a large mouth area. Its breadth in the eye region nearly equals that of the anterior margin of the prothorax which overlaps it. It is a little longer than the prothorax, but about as long as the mess — and metathorax combined. The epicranial suture (Plate I, figs 2 and 4 E.S) runs from the posterior margin of the head as far as the line joining the anterior margin of the eyes. At first it is a clear suture, then

for a short distance it is not clear, and finally is continued as a heavily chitinised line. There are no epicranial arms defining the frontal area which is completely fused with the epicranium. The dorsal side of the head capsule ends anteriorly at the epistoma which runs across the head and to which the labrum is attached by a narrow membrane. The mandibles are articulated

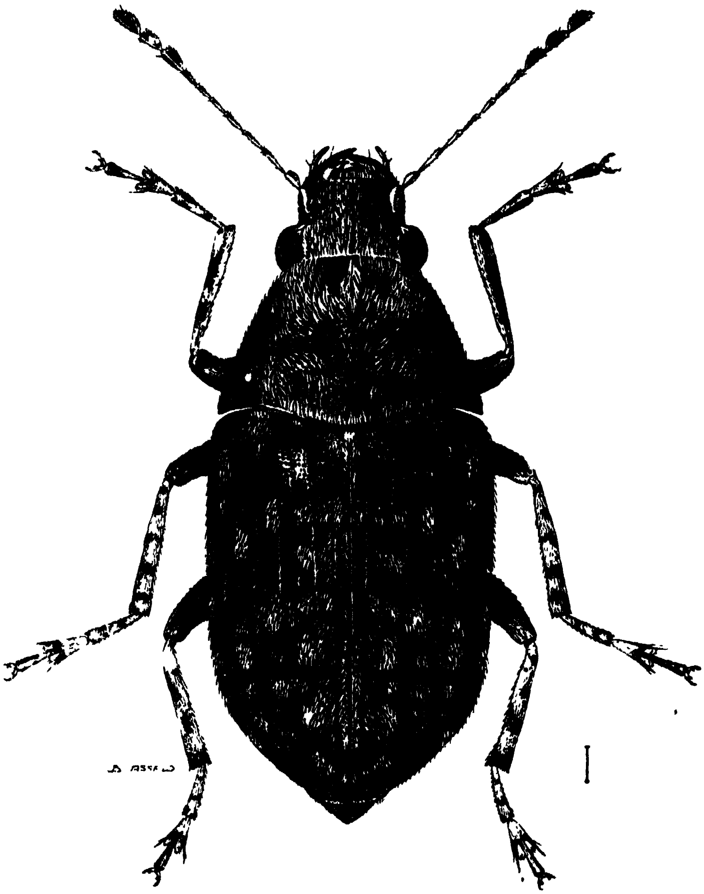


Fig. 1. — *Araecerus fasciculatus* De Geer : adult. — × 18.

to the ends of the epistoma. The fusion of the sclerites is continued on the lower side of the head (Plate I, fig. 3). On the ventral side, the head capsule ends in a bilobed structure (labiophore [Jordan]) to which the labium is connected. The head is constricted ventrally and laterally by a well marked depression. This separates the pregenal area and the bilobed structure from the rest of the head. There is no gula. The occipital foramen (Plate I, fig. 30F) is fairly large, triangular and is bounded by a less chitinised area.

The occipital apodeme, which is partly hidden by the occipital area, is continuous with the epicranial suture.

Vestiture

There are whitish bristles clothing the dorsal side and these are very few posteriorly where it is covered by the pronotum. The ventro-lateral area representing the pregena is clothed with bristles. The largest part of the ventral side of the head (bounded anteriorly and laterally by the depression already mentioned) is without bristles. The head is dorsally ornamented by pentagonal areas with narrow and more chitinised areas in between, i.e. clathrate. The bristles arise from the pentagonal areas (Plate I, fig. 5). This ornamentation is not clear in the frontal area behind the epistoma. The ventral aspect of the head shows very thin transverse ridges and furrows.

The Epistoma

The epistoma is represented in both adults and larvae Externally it is the fronto-clypeal area defined from the rest of the head by a marked elevation. It shows some homology with that of *Dendroctonus valens* studied by Hopkins (1921, pp. 11-13). There is a fringe of bristles in the centre, almost covering the labrum. These (Plate I, figs 1, 2, 4 and 5) tend to converge distally. Laterally, there are the epistomal processes: these seem to correspond with the « precoila » of Stickney (1923) and from each of them arises a fringe of bristles directed towards the labrum. The ventral aspect of the epistoma (Plate I, fig. 6) shows a nearly rectangular median piece not in contact with the head posteriorly but fused with it anteriorly. Its chitinisation is not uniform. This piece is demarked from the lateral arms which end with the dorsal condyle. articulating with the dorsal fossa of the mandible. The epistoma supports the labrum and forms a strong bridge over the oval foramen.

The Hypostoma

The hypostoma (Plate I, fig. 7) is a broad, transverse piece stretching across the ventral and anterior part of the head. Its functions are similar to those of the epistoma. The hypostoma and epistoma, together with the mouth parts attached to them form the boundaries of the oral foramen. The central portion of the hypostoma is striated and less chitinised towards the sides. Its extreme lateral ends provide for the articulation of the mandibles through a fossa (Plate I, fig. 7 V.F) into which fits the ventral condyle of the mandible. Posteriorly, there are two strong, semi-circular apodemes beneath which the cardo of the maxilla is articulated to the maxillary condyle. This is a thickened bar at the posterior edge of the hypostoma. Most

of the cardo and the stipes lie between the hypostoma and the labiophore which is only a continuation of the ventral part of the head, although it is similar in shape to the submentum of many beetles.

The Mouth Parts

The *mandibles* (Plate II, figs 8-10) are prominent, triangular and well adapted for biting. Each mandible terminates acutely at the distal end with the apical tooth. Below this, is the sub-apical tooth which is also pointed. The median tooth is well behind them and is not very pointed. The basal tooth or the molar is broad, and strongly chitinised, constituting nearly half of the inner side of the mandibles. It is used more for crushing than biting. There are four groups of bristles on the mandible.

Dorso-laterally, there are about eight long bristles (Plate II, fig. 8a) arising from a ridge extending along the lateral side of the mandible.

Below and on the same ridge, there is nearly the same number of smaller bristles (Plate II, fig. 8b).

Numerous small bristles (Plate II, fig. 8c) on the lateral aspect run as far as the lateral condyle.

The fourth group of bristles (Plate II, fig. 8d) is dorsal and they vary in length.

The mandible is articulated with the head in three places. At the end of the lateral arm of the epistoma is a globular condyle (Plate I, fig. 6D.C) which fits into the dorsal fossa of the mandible. Laterally, the articulation is made by the long condyle which projects beyond the base of the mandible fitting into a lateral socket in the pregenal area. The ventral condyle is a rounded head which fits into a socket in the antero-lateral ends of the hypostoma.

Each mandible has a large adductor muscle at the base of the molar and a smaller abductor muscle at the base of the lateral condyle. The adductor muscle is darkly coloured near its attachment with the mandible. At the base of the adductor muscle, a small elliptical structure arises and is termed by Hopkins the « pharyngeal process ». It is firmly connected to the mandible and its base is only attached to the pharynx by muscles. Hence, the name « pharyngeal process » does not seem to be appropriate. « Mandibular process » seems to be a more suitable one. It is known as « appendice interna della mandibola » by Russo (1926) in his study of *Chaetoptelius vestitus;* its distal end is covered by elongated papillae. Associated with the mandibles, there is a mandibular gland. This is fairly long, narrow and convoluted, found in both mandibles in both sexes. It is usually found curled up in the pregenal area and liable to be overlooked. The gland swells anteriorly then it ends in a cavity in the base of the mandible. It has a very narrow duct with a row of elongated cells on either side. The nuclei

of the cells are relatively large and peripheral. Mandibular glands are not usually found in Coleoptera. It is probable that they function as salivary glands and through them external digestion might occur to a certain extent.

The *labrum* (Plate I, fig. 5, and Plate II, figs 11 and 12) is quite a distinct organ in all *Anthribidae*, but absent in the majority of Rhynchophora. It is nearly elliptical in shape. Its inner edge close to the epistoma is more chitinised than the distal end.

The labrum is lined ventrally by a membranous epipharynx (Plate II, fig. 12), on which most of the bristles arise. With the labrum the latter forms a double convex structure. On the anterior edge of the epipharynx there are about eighteen strong bristles. Smaller ones of nearly the same number are found on each side, the central area being without any. Dorsally, there is a pair of long hairs on each side and a pair of median short hairs. The latter is on the anterior edge. The clypeus is probably represented by the narrow, membranous structure between the labrum and the epistoma. Hopkins thinks that the anterior margin of the epistoma with the epistomal bristles in *Dendroctonus valens* (which are also present in *Araecerus fasciculatus* De Geer) might represent the clypeus. This view could only be ascertained by a thorough study of the origin of the epistoma and its bristles.

The Labium (Plate II, fig. 13)

The mentum, palpifer, glossa and paraglossa are not found as separate elements in the labium of *Araecerus fasciculatus* De Geer. The mentum as a secondary segment between the prementum and the submentum is not found, but probably one might in this case consider the prementum and submentum as the anterior and posterior parts of the mentum respectively. The prementum is apparently attached to the head between the two lobes of the labiophore. Actually, there is a very small structure hidden between the two which can only be seen by dissection. This is less chitinised than the prementum and probably represents the submentum. As shown in the figure, there is a hole at the base of the prementum through which muscular bands pass to the head. The hidden structure representing the submentum is fused with the head and fits into the base of the prementum.

The labial palpi are quite distinct, with three segments (of which the middle one is small). They are longer than the prementum and the ligula combined. The ligula is situated between the palpi and represents the glossa and paraglossa of other insects. There is a set of long and strong lacinial hairs at the anterior margin. Also, there are several hairs on the ventral side and these extend to the prementum.

The writer has noticed a very abnormal labium (Plate II, fig 14) in which the ligula and palpi are all represented by a single 3-jointed palpus. The prementum is also much smaller than usual. No abnormality has been noticed in the other mouth parts.

The *maxilla* is a very prominent structure with its relative proportions as shown in Plate II, fig. 15.

The cardo or hinge is the long, narrow basal section and articulates with the maxillary condyle on the posterior end of the hypostoma (Plate I, fig. 7). Its movement is effected by a muscle attached to its basal process.

The stipes is articulated to the distal end of the cardo and is not well defined from the lacinia except that the latter is distinguished by the presence of strong lacinial bristles. It is a blade-like structure with numerous hairs on its ventral surface and fewer hairs dorsally.

The galea is much smaller than the lacinia and joins posteriorly the small membranous area of the subgalea. Most of the bristles of the galea are on the distal end, there being a few on the disc and the inner margin. No bristles are found on the subgalea. The palpifer may be represented by the part of the stipes cut off at the base of the maxillary palpi. The palpi are composed of four segments, connected with each other by flexible membrane. The basal segment is the smallest and lies over the palpifer region. The second is very broad but short. The distal segment is nearly as long as the other three combined.

The Antennae

The antennae (Plate II, figs. 16, 17 and 18) arise in front of the dorsal margin of the eyes and consist of eleven segments forming three groups, differing in size and shape — the scape and pedicel, the club or the last three segments and the funicle in between.

The scape is the first or basal segment of the antenna; it is large and swollen distally.

The pedicel is the second segment; it is smaller than the scape but nearly similar to it in shape. Most of the bristles are on its end where it joins the third segment (Plate II, fig. 17). The third to the eighth segments are much thinner than the remainder and filiform in shape. The third segment is the longest, the fourth to the eighth becoming successively shorter. These are followed by the last three segments constituting the club (Plate II, fig. 18). They are much more chitinised than the rest of the antenna and are thickly clothed with bristles. There is a longitudinal ridge on each side of the club segments. In rare cases the first two segments of the club coalesce at one side.

2. The Thorax

The prothorax articulates freely with the mesothorax and overlaps nearly all its tergal area. On the other hand, the meso- and metathorax are firmly connected in their sternites and pleurites. The dorsal area of the thorax is

nearly as long as that of the abdomen. In the natural position the pronotum or the tergal area of the prothorax is slightly longer than that of the meso- and metaterga combined. The combined length of the abdominal pleurites is greater than that of the thoracic ones represented in the meso- and metathorax. The sclerites are well defined in the metathorax, less distinct in the mesothorax and completely fused in the prothorax.

The Prothorax

The prothorax has the shape of a truncated cone and as in most Rhynchophora its tergal, pleural and sternal elements are nearly fused. There is an indication of a suture from the fore coxa upward, and the intercoxal ridge is divided into anterior portion and a posterior portion. the hairs directed backward and forward respectively. It is nearly $1\frac{1}{2}$ times as broad as it is long; but posteriorly, it is nearly twice as broad as anteriorly. The lateral margins are convergent anteriorly (Plate II, fig. 19). The posterior declivity which according to Hopkins may represent the post-scutellum is bounded by the dorsal and the basal margins (Plate II, figs. 19 and 21). The area enclosed between the two margins of the posterior declivity is narrowed in the centre and is broader at each side. The dorsal carina is much thicker than the anterior margin and in the natural position it is curved in the centre and on each side (Plate II, fig. 19). Laterally, and on each side of the posterior foramen, there is a triangular area which extends as far as the first thoracic spiracle. The lateral end of the basal margin is tubercular and forms one side of the triangular area. The pronotum or tergal area is uniformly reticulated like the head and light in colour, except for very dark, central and lateral areas. Bristles are evenly distributed, one in each mesh of the network.

The ventral aspect of Prothorax

The ventral erea is punctured except in the sternal and intercoxal areas. The pubescence in the former (Plate II, fig. 20) and behind the coxae is short, these hairs being thin; those of sternal area directed backward. The exo-coxal and episternal areas are elevated, whereas the epimeral area is on a lower level and is much flattened. Laterally between the tergum and the sternum, there is a dark, acute ridge running from the posterior angle for about half the distance to the anterior margin, the « lateral carina » of taxonomists.

The Mesothorax

The *mesotergum* (Plate III, figs. 22 and 23) is very short and narrow when compared with the other tergal areas of the thorax. In the natural

position it is partly hidden by the pronotum and partly by the elytra with only the end of the scutellum exposed between the inner angles of the elytra. The mesotergum is pushed so much forward that its posterior margin lies as ar forward as the presternum. It is rectangular in shape and more chitinised than the metatergum; but much less chitinised than the pronotum. It is composed of four parts:

The ***prescutum*** is a large, subtriangular area occupying more than two-thirds of the total area of the mesotergum and is much better defined than the other divisions. Its anterior margin is concave with the prephragma strongly flexed ventrally. The prephragma (Plate III, fig. 22) is shown in an anterior view. Attached to the prephragma is the intersegmental membrane that joins the mesothorax with the prothorax and in which the first pair of stomata is located. The lateral arms of the prephragma and the prescutum combine and are much produced. The prescutum is divided internally into two equal parts by a longitudinal ridge or apodeme which runs posteriorly as far as the scutellum. Most of the prescutum except the anterior part is covered with characteristic vestiture. The vestiture is composed of small chitinised areas and from each a small thin bristle arises. The lateral areas of the prescutum are strongly flexed. Prescutal lobes are not clear and are probably represented by the slight projection anterior to the lateral arm of the postphragma.

The *scutum* is the oblique area lying close to the posterior-lateral margin of the prescutum and is not well defined from it dorsally. It consists of two areas different in size, an anterior one with bristles on its margin, and a smaller posterior one reaching the scutellum. Both areas have the same vestiture as the prescutum.

The *scutellum* is more clearly defined than the scutum and represented by the median posterior process and two lateral triangular areas. The median process is clothed dorsally with bristles and is the only part of the mesotergum exposed. It lies between the inner angles of the elytra. It is constricted from the rest of the scutellum and is on a higher level from the rest of the mesotergum. The lateral areas of the scutellum are less chitinised than the median part.

The *post-scutellum* is represented by two lateral membranous areas on both sides of the scutum. Each of these areas ends in a long curved hook — the lateral or mesonotal process which Hopkins calls the « lateral arm of postphragma » and probably represents the « yoke plate » of Snodgrass and the « ligamento » of Berlese. Although they are shown in the dorsal aspect of the mesotergum (Plate III, fig. 22) to indicate their position, yet they are always flexed ventrally and are attached to the lateral arms of the prephragma of the metatergum.

The above interpretations differ from those of Snodgrass (1909) in

his study of the mesotergum of *Calosoma scrutator* in which he considers the large triangular area to represent the scutellum. The writer thinks that Hopkins's nomenclature in his study of *Dendroctonus valens* is the more satisfactory. It is the presence of the anterior lateral processes in conjunction with those of the prephragma and also the accessories for the articulation of the elytra that indicate the position of the prescutum. It is doubtful if what Hopkins describes as the « prescutal lobes » correspond to those of the metatergum.

The ventral aspect of Mesotergum

Ventrally, the mesotergum is strongly concave with its lateral areas directed upwards. The concavity fits on the anterior part of the metatergum which is flexed ventrally and is overhung by the mesotergum (as mentioned above in connection with the mesonotal processes). There are two main ridges or apodemes — a transverse and a longitudinal one (Plate III, fig. 23). The former extends anteriorly along the prephragmal area, narrowed in the centre and broad on either side. The latter vertical apodeme is very prominent, and it divides the prescutum into two equal halves and is perpendicular to the transverse apodeme.

The *mesotergum* consists of the presternum and sternum. The *presternum* is represented by the anterior, narrow band in front of the sternum. It is less chitinised than the rest of the mesosternum and in the natural position it is covered by the post-sternal area of the prothorax.

The *sternum* is a broad structure, limited anteriorly by the presternum, laterally by the area representing the episternum and posteriorly by the mesocoxae and the anterior part of the metasternum (Plate III, fig. 24). The intercoxal or sternellar area is elevated with a strongly chitinised edge upon which very small bristles arise.

The *mesopleura* are represented by the episternum (fused with the mesosternum), pre-episternum and epimeron.

The *episternum* is represented by the lateral area fused with the sternum and lies between the pre-episternum and the epimeron. It corresponds in its relative position to the well defined episternum of *Chaetoptelius vestitus* studied by Russo (1926). In *Araecerus fasciculatus* De Geer this area is marked by the definite distribution of the tubercles and pubescence which clothe it more than any part of the sternum. A comparision which other Anthribidae, in which the episternum is distinct, proves that in *Araecerus* it is fused with the sternum.

The *pre-episternum* lies anterior to the episternal area. It is subtriangular with an acute anterior angle which is concave internally making a pocket-like structure. As in most Rhynchophora, it bears what is termed the pre-episternal process (Plate III, fig. 24 P.EPS.P) and in *Araecerus fasciculatus*

De Geer this is fused with the anterior angle of the pre-episternum and joins the first axillary sclerite of the elytra by a ligament. The pre-episternum itself is strongly attached to the first axillary sclerite by a tendon that runs along the inner side of the former (Plate III, fig. 34). It is fused posteriorly with the presternum and episternal area and is marked from them by discontinous line at its base. Powerful muscles join it to the posterior wall of the pronotum.

The *epimeron* is a large triangular piece situated between the metasternum and meta-episternum on one side and the meso-episternal area on the other. The suture separating it from the episternal area is not as marked as the one between it and the meta-episternum.

The Metathorax

The *metatergum* (Plate III, fig. 25) is a large oblong area, placed further forward than the metasternum, so that its middle part lies dorsal to the mid-coxa. It consists of the notum and postnotum. The notum is a large plate, convex dorsally. It is called the scuto-scutellum by Crampton. It covers practically the whole segment and to it both the preceding tergum and the wings are attached. It consists of the prescutum, scutum and scutellum.

The *prescutum* (Plate III, figs. 25 and 26) is the anterior transverse section of the notum and is less chitinised than the rest of it. It is the « protergite » of Berlese (1909). It slopes downwards and is more or less vertical anteriorly and is overhung by the mesotergum to which it is attached through a pointed process known as the « lateral arm of prephragma » by Hopkins and the « clavicola » by Berlese. This process is attached to the mesonotal process already mentioned. In the median section and between the two lateral processes there are two prephragmal lobes to which the median metathoracic muscles are attached anteriorly. The prephragma is known as the « acrotergite » by Berlese. On either side of the lateral arm of the prephragma, there is a membrane stretching laterally as far as the anterior notal process and then to the costal area of the wing. The muscle disc lies in this membrane and serves for the attachment of a small muscle which ends in the pleural clavicula. Lying in the membrane between the muscle disc and the lateral arm of the prephragma there is a chitinous rod, hooked on one end, probably corresponding to the « anterior disc » of Hopkins. The prescutum consists of :

(a) Median prescutal area (Plate III, fig. 25 M.PS.A) is nearly semi-circular, and is limited anteriorly by the prephragma and posteriorly by the membranous area. Two small triangular pieces arise from it posteriorly.

(b) The prescutal lobes lie on both sides of (a). They are oblong in shape, their anterior angles fused with the lateral arms of the prephragma.

The prescutum continues laterally beyond the prescutal lobes into a

narrow band which is folded internally into a shelf or pocket-like structure bent inwards beneath the anterior scutal lobes. The extreme lateral end of the prescutum is directed posteriorly and forms another pocket or shelf internally. These two folds are dotted in the figures 25 and 26 of Plate III. The anterior notal process (Plate III, fig. 25 A.N.P.) is at the anterior angle of the lateral area. It is termed the « prescutal process » by Hopkins, the « suralar process » by Crampton and the « precondilo » by Berlese. To this process the anterior part of the first axillary sclerite is attached.

(c) The membranous area (Plate III, fig. 25 M.A.) is limited anteriorly by the median prescutal area, antero-laterally by the prescutal lobes, laterally by the anterior scutal lobes and posteriorly by what Hopkins calls the « anterior suture » (dorsally) and « apodeme » (ventrally) and which is termed the « transverse ventral ridge » by Snodgrass.

The *scutum* or the « mesotergite » of Berlese is separated from the scutellum by two prominent oblique apodemes known as the « entodorsum » by Snodgrass and the « median apodeme » by Hopkins and Russo. It consists of two large scutal lobes and two smaller ones which correspond in position to what Hopkins calls « prescutal lobes », thus considering them part of the prescutum. This depends, of course, on their position with regard to the anterior suture or apodeme. However, the writer agrees with Jackson in considering these a part of the scutum for there is no definite suture between them and the large scutal lobes.

Besides these two lobes, there is a lateral elongated area known as the lateral margin of the scutum. It merges anteriorly into the anterior scutal lobes and is produced laterally into the posterior notal process, known as the « scutellar process » by Hopkins and the « mesocondilo » by Berlese. This process is attached to the posterior part of the third axillary sclerite by a membrane as shown in Plate III, fig. 28. Besides this process, there is another one anterior to it and directed towards the wing. This is not represented in *Dendroctonus valens* or *Sitona hispidula* studied by Hopkins and Jackson respectively. The lateral margin of the scutum is attached to the base of the wing by a membrane which extends anteriorly as far as the prephragma.

The *scutellum* or the « metatergite » of Berlese is the median and more or less triangular area and separates the scutum into two parts. Its central area is known as the median groove and is ridged internally on both sides. It is limited anteriorly by the transverse, anterior apodeme and is not continuous to the end of the notum.

The *postnotum* or the « pseudonotum » is a narrow, transverse structure lying immediately behind the notum (Plate III, figs. 25 and 27). Laterally it expands into a small, anterior and larger, posterior process. The former is attached to the epimeron by a chitinous piece termed by Hopkins the

« metapleural hook » (Plate III, fig. 30) and by a membrane to the base of the wing (Plate III, fig. 28). The larger process expands ventrally and is situated beneath the first abdominal tergite. The lateral metathoracic muscles are attached to the expanded end of the postnotum. From the posterior edge of the postnotum, the postphragma (Plate III, fig. 27) arises and consists of two lobes to which the median metathoracic muscles are attached.

The *metapleura* (Plate III, figs. 29 and 30) differ from the mesopleura in being represented by two definite areas. A more chitinous, triangular piece on the lateral side of the insect represents the episternum. Another less chitinised and in some parts membranous piece lies above the previous one, edge to edge, and represents the epimeron. This is covered by the elytra when they are closed.

The *episternum* consists of two areas, a more chitinised one with tubercles and long bristles similar to those on the sternites, and a much less chitinised dorsal portion. The less chitinised area (Plate III, fig. 29) thins out anteriorly into a chitinous process known as the parapterum and called the « clavicle process » by Hopkins. To this process, the head of the costal vein of the wing is attached by a ligament. What appears to be the posterior end of the episternum, but is really the posterior end of the epimeron is articulated with the distal end of the hind coxa by a ligament, condyle and fossa. There is also a strong ligament between the posterior end of the episternum and the lateral angle of the meta-sternellar area.

What I designate as the epimeron is composed in other beetles, for example Lamellicornia, of at least 3 sclerites. In *Araecerus* all are fused with each other and with the episternum.

The *epimeron* ends anteriorly with a process adjacent and similar to the parapterum. This is known as the wing process, the « coracoid process » of Hopkins and the « fulcro » or « processo alifero » of Berlese. This process is attached to the head of the sub-costal vein of the wing and also to the head of the first axillary sclerite. Between the epimeron and the less chitinised portion of the episternum there is the pleural ridge which also shows internally especially at its posterior end. The posterior end of the epimeron is nearly semi-circular and more chitinised than the rest of the epimeron. To its dorsal edge a chitinous hook is attached (Plate III, fig. 30). As mentioned above, this process joins the epimeron with the anterior process of the postnotum. On the ventral side of the parapterum and some distance from its end a muscle disc arises. This is known as the « clavicle disc » by Hopkins and the « pronator » or the «parapteral disc» by Jackson. It is a large funnel-like structure with a long stalk.

The Metasternum

The *metasternum* (Plate III, fig. 24) is a broad, rectangular area, divided into two lateral areas by a median line which does not quite reach either the anterior or the posterior margin of the sternum. It is limited anteriorly by the mesosternum and the posterior part of the mesopleura and laterally by the meta-episternum.

The *sternum* constitutes most of the area clothed with the bristles dorsally and with tubercles similar to those referred to in the mesosternum ; but these tubercles are not found in the central area. The median line dividing it is ridged internally and is perpendicular to the transverse ridge which lies between the sternum and what Hopkins calls the «sternellar area».

The *sternellum* and the *sternellar piece* lie posterior to the sternum and constitute a narrow, transverse band. The median area is the sternellar piece. Internally, its median line is ridged adapted for the attachment of the endoskeleton. Below the sternellum lies the hind coxa.

The Endoskeleton

The *endoskeleton* (Plate III, fig. 31) is a Y-shaped structure. It has two anterior arms between which and in the middle line there is a longitudinal ridge or apodeme which in the natural position is directed ventrally. The posterior end fits into the sternellar piece (as already mentioned) and makes an acute angle with it. This results from the articulation of the posterior processes of the endoskeleton into two grooves found on the produced ends of the sternellar piece. Anteriorly, there is a transverse apodeme making an obtuse angle with the longitudinal one and extending laterally to the arms of the endoskeleton. There is another transverse ridge and this with the other ones make two lateral pockets or folds for the attachment of the muscles. The posterior end of the endoskeleton in grooved dorsally.

The Mesothoracic Wings or Elytra

The elytra (Plate III, fig. 32) are wide structures with broad, declivous base, provided with a prominent articulating head or basal process. Both the upper and lower surfaces are chitinised. The former is thick, rough, more chitinised, with bristles and deep sculpture, while the latter is comparatively thin, smooth, leathery and with the sculpturing less distinct.

Sculpture : The striae are the principal features of the sculpture and consist of rows of punctures. Although these are more marked on the upper surface, they are best seen on the inside as tubercles, for the bristles spread all over the upper surface tend to hide them. The interspaces are the longitudinal spaces between the rows of striae or between them and the costal and anal margins. In the elytron of *Araecerus fasciculatus* De Geer there are 11

striae and 12 interspaces. In referring to these, they are numbered beginning from the dorsal suture when the elytra are closed. This corresponds to the anal margin when they are open. The interspace 1 which is called the sutural interspace is elevated at the base and continuous to the apex where it joins interspace 12 or the « costal one ». Interspace 2 is very short and runs from the base for nearly one-third the length of the elytron, where striae 1 and 2 meet. The interspaces 10 and 11 merge for a short distance where the costal groove (which fits into the dorsal margin of the episternum) interrupts their course. Stria 11 passes outside the groove and joins stria 10 some distance from the apex, where they continue as one stria to the apex. Here, this is continuous with striae 1 and 2 combined.

Vestiture : The upper surface of the elytron is covered with dark and light bristles of different diameters but nearly all of equal length and directed towards the apex.

Tracheation : There are five main tracheae running in the interspaces of the elytron giving off smaller branches in the lower surface. They arise from two larger ones coming from the mesotergum. The outer one divides into a short, costal one which does not run far along the costal margin taking the course of the last interspace. The other one runs in the interspace 10 and though much longer, does not reach the apex.

The other three tracheae are branches of the second main trachea and are all long. Their positions as indicated in Plate III, fig. 32. are in the interspaces (1 and 2), 4 and 6. The anal one takes the course of the second then the first interspace.

Articulation of the elytron, mesotergum and mesopleurite : The produced articulatory arm at the base of the elytron is supposed to represent the heads of the costa, subcosta and median veins fused together. The sclerites here (Plate IV, fig. 34) are not quite identical with those of the fore-wing (as it will appear later), and also the relative position is different. The articulation is made as follows :

(a) The ***scapular*** or first axillary sclerite is similar in shape to that of the hind-wing. Here, the anterior end of the arm joins the lateral arm of the prescutum, its convex base fits the basal process or the articulatory arm of the elytron. Its ventral area is attached to the inner margin of the pre-episternum by a prominent ligament. Laterally, it joins the pre-episternal process

(b) The *subscapular* or second axillary sclerite is quite different in shape and position when compared with the corresponding one of the hind wing. It lies between the prescutum and the basal process of the elytron but is not directly in contact with the latter. Its anterior arm joins the lateral edge of the prescutum by a ligament. It has two posterior arms. From its centre, there arises a faintly chitinised piece which probably represents the radial plate. This is perpendicular to a club-like plate which stretches to the posterior

margin of the basal process. This club and the triangular area at its base with the faintly chitinised one in between, probably represents the medial plate. Both the club and the radial plate appear vesicular in structure.

(c) The *flexor* plate or third axillary sclerite is quite similar in shape to its corresponding one in the hind-wing. It is a narrow structure with two arms. The anterior one lies behind the posterior end of (b), and the posterior one is attached to the base of the elytron.

The Hind Wings

The wing (Plate IV, fig. 35) is more or less oblong with the costal and anal margins nearly parallel as far as the apex. There are five main veins in the hind wing; the costa, sub-costa, radius media and cubitus.

The *costa* is separate from the sub-costa at the base of the wing but merges into it distally. As shown in Plate III, fig. 28, its base is attached to that of the sub-costa by a chitinous spur which is seen ventrally lying over the base of the latter. There is another narrow, indirect connection between the costa and the head of the sub-costa. As already mentioned, the head of the costa is attached by tendons to the parapterum of the metapleurum.

The *sub-costa* begins with a prominent base which is attached to both the wing process and to the head of the first axillary sclerite. The sub-costa is considerably swollen at its base. It is only distinguishable from the costa for a short distance and beyond that, the two combine into a single vein along the costal margin of the wing, finally fading away. Between the base of the sub-costa and the second axillary sclerite, there is an elongated plate corresponding in position to the radial plate described by Jackson in the wing of *Sitona hispidula* F. The writer proposes to call it the sub-costal plate as it is far from the radius in *Araecerus fasciculatus* De Geer wing.

The *radius* (Plate III, fig. 28) is very narrow and indistinct at the base where it joins the radial plate. The vein runs nearly half the length of the wing parallel to the costal margin. It then turns towards the margin and just before its termination, a chitinous spur directed towards the base arises. This represents the « recurrent radial » of d'Orchymont (1921).

The *media* runs towards the anal margin of the wing making with the radius an angle of nearly 40°. There is a trace of an incomplete cross connection at the base. There, the media begins to thin out until it reaches the more or less triangular median plate — a large structure that runs posteriorly to the base of the cubitus, and is attached to two other plates of more or less rectangular shape lying between the second and third axillary sclerites. Along the course of the media, there is a prominent chitinous spur directed backwards, representing the « recurrent media » of d'Orchymont. It runs towards the recurrent radial and there is a rudimentary connection between the two.

The *cubitus* is very thin at the base until it reaches the posterior end of the triangular median plate Most probably, this vein represents CU2, whereas CU1 is represented by its remaining anal portion between the media and CU2.

There is no distinct anal vein. There are no veins in the apical half of the wing, but there are faint dark stripes of which there are two main ones — an anterior one directed towards the apex and a narrow one arising close to the recurrent media and directed towards the anal margin taking the course of M1 in *Dendroctonus valens*. There are two other small ones — one at the end of the media extending to the anal margin, the other begins at the end of the radius and directed towards the costal margin. Except for these stripes and veins the wing is membranous. Of the veins, the radius and media are much chitinised except at the base.

The interpretations employed above in describing the veins are in accordance with those of Jackson and (to a less extent) Hopkins for the venation of *Sitona hispidula* F. and *Dendroctonus valens* respectively. Both *Araecerus fasciculatus* De Geer and *Sitona hispidula* F. are so much specialised in their venation, that it is very difficult to find out the exact relationship between them and the hypothetical type outlined by Graham or even the Cerambycid type which is considered to be the nearest approch to the Rhynchophora.

Chaetotaxy and distribution of «vesicles» on the wing: There are a great number of minute bristles distributed all over the surface except at the bases of the veins and in the radial or median plates. Bristles of different sizes occur and these take definite directions. They are very minute in the anal region, and much more conspicuous and crowded in the apical half of the wing. They are abundant and long along the anal margin but are not found in the basal margin. There is a group of small bristles on the costal vein, much lighter in colour, some of which are more conspicuous than the others.

Besides the bristles, there are minute, rounded, clear bodies, with a double edge. These might correspond to what Jackson (1928) describes as « vesicles » in the wing of *Sitona hispidula* F.. They are found in groups (Plate III, fig. 28) at the base of the wing, mostly on the veins. They are numerous at the base of the radius where they become crowded at one end and are of different sizes. There is another group on the radial plate near the sub-costal margin. Few are found on the sub-costa, but more on the media and about eight of them on the cubitus. Their function is unknown, but they are supposed to be balancing organs.

The *folds of the wing* (Plate IV, fig. 36) : The wing is folded when not in use. The wing is narrowed and shortened by the longitudinal and transverse folds respectively. Longitudinal folds occur between the veins or in the lines of least resistance, whereas transverse ones are found in the apical half of the wing where there are no veins. The longitudinal folds are :

(a) A ventrally-directed anal fold which extends from the base of the anal margin parallel to CU2. The area folded in is triangular and covers most of CU2 and the basal part of the media.

(b) This is made by the apical part of the anal margin being folded dorsally towards the costal margin. This fold precedes the transverse folds (a) and (b).

(c) Sometimes, the part folded by fold (b) is folded again away from the costal margin. This also precedes the transverse folds and is not indicated in the figure. The transverse folds are:

(1) From the end of the radius to the anal end of the media. This fold bends the apical half of the wing ventrally.

(2) Of the part folded ventrally in the previous fold, the apex is folded back dorsally. Sometimes this is followed by the folding back of the apex towards the base of the wing.

The articulation of the Hind Wing

The articulation of the wing is carried out by the axillary sclerites, the anterior and posterior notal processes of the metatergum, the parapterum and wing process of the metapleuron.

The first axillary sclerite (Plate III, fig. 28) is termed the « scapular plate » by Hopkins, the « notopterale » by Crampton and « protero » by Berlese. Its head articulates anteriorly with that of the sub-costa, and ventrally with the metapleural wing-process. The curved part of its arm is attached to the anterior notal process and beyond that is attached to the lateral edge of the prescutum.

The second axillary sclerite is termed the « subscapular plate » by Hopkins and « medipterale » by Crampton and the « mesoptero » by Berlese. It is attached to the 1st axillary sclerite and underlies its posterior part (Plate III, fig. 28). The inner part of this sclerite is less chitinised than the part adjacent to the first axillary sclerite and from it the sub-costal plate runs obliquely to the base of the sub-costal vein.

The third axillary sclerite is termed the « flexor plate » by Hopkins the « basanale » by Crampton and the « metaptero » by Berlese. It is united by its inner end to the large triangular, median plate. Like the other two sclerites, the third axillary sclerite is not uniformly chitinised, its transverse part being more chitinised than the vertical. Besides the triangular part of the median plate mentioned above, it has two other divisions, each roughly rectangular in shape and more chitinised. The median plate connects the second and third axillaries with the bases of the media and cubitus veins; it is not well defined.

The Legs

The legs (Plate I, fig. 1; Plate IV, fig. 37) are large when compared with the size of the body. In *Araecerus* the fore tibia and fore tarsus seem to be sexually different, but such differences are not conspicuous. There is a very narrow space between the procoxae; the mesocoxae are wide apart, being separated by the elevated intercoxal area of the mesosternum and the « intercoxal process » (Hopkins) of the metasternum (Plate III, fig. 24). The metacoxae (Plate I, fig. 1; Plate III, fig. 24; Plate IV, figs. 40 and 41) differ considerably from the other two pairs.

The fore and mid coxa are nearly similar in shape. The former (Plate IV, fig. 37) is somewhat rounded, but with a straight anterior edge to which a strong apodeme is attached. This is represented in the mid coxa as well, but is missing in the hind coxa. At the posterior end of the procoxa there is a transverse groove which is highly chitinised and another, oblique, groove on the outer side.

The mesocoxa (Plate IV, fig. 39) is oblong with its inner surface slightly chitinised and without the transverse groove which is found in the procoxa. The articulation of the coxa with the trochanter is made by a rounded process on the trochanter which fits into a groove on the coxa. The metacoxa is a large, elongated structure with the cavity for the reception of the trochanter near its broad, distal end (Plate I, fig. 1; Plate III, fig 24; Plate IV, figs. 40 and 41).

The coxa is narrow where it articulates with the posterior end of the meta-episternum through a fossa and condyle in the latter (Plate IV, fig. 41). There is also a strong ligament strengthening this connection. The metacoxa is hollow with less chitinised lateral edges folded inwards especially at the broad end where a strong muscle disc arises, to which the muscles of the coxa are attached. Two transverse sutures run from the cavity for the articulation of the trochanter but they do not reach the proximal end of the coxa. On either side of the posterior suture there are tubercles of the same kind as those found on the sterna of the thorax.

The *trochanter* is the second and the smallest segment of the leg. It is sub-triangular and joins the coxa by means of a rounded condyle that fits into a groove at the base of the coxa. There are strong ligaments between the two. Bristles are mostly found on its inner side (Plate IV, fig. 37).

The *femur* is the third and largest segment of the leg. Its basal end fits into the trochanter. Its distal end is much hollowed out on the underside where it joins the tibia, and this allows the movement and folding of the latter. Along the sides of this hollow, there is a marked chitinisation (Plate IV, fig. 42). The distribution of bristles is not uniform on the underside of the femur.

The *tibia* is nearly as long as the trochanter and femur combined, but

more slender than the femur. It has serrated edges, being spinose especially on its inner side. These are more clear in some specimens than in others. Its base is pivoted to the distal end of the femur and it moves freely into the excavation of the underside of the femur. Its distal end is hollowed out and receives the rounded basal end of the first tarsal joint. The edges of this hollow are armed with very short but strong spines.

The *tarsus* (Plate IV, figs 37 and 38) is composed of five segments which together are longer than the tibia. The first segment, known as the basitarsus, is comparatively long with a slightly serrated surface It is narrowed at the base where it is articulated with the tibia. The second tarsal segment is smaller but distally broader and with strong bristles, where it joins the bilobed third joint. This segment has a narrow base and the lobes are conspicuous enclosing between them the fourth and the smallest segment of the tarsus and also the basal part of the fifth segment. On the dorsal surface of the lobes, there are long, dark bristles of the same kind as are found on the rest of the leg, whereas the ventral surface is clothed with very fine hairs of a glandular nature as shown in their bases in Plate IV, figure 38. The fifth segment is about as long as the second but is very slender and at its apex there are two claws, each divided on the inside into two parts. Muscles join the inner part of their bases to the fifth segment.

3. The Abdomen

Tergites : In both male and female there are seven external tergites of which six are normally covered by the elytra. The seventh segment forming the pro-pygidium and the pygidium is much more heavily chitinised than the preceding ones. The remaining tergites are not equally chitinised (Plate IV, fig. 43). The first tergum is nearly membranous, while the second is slightly chitinised. The tergites 3-6 show marked, transverse chitinised areas on either side of the median line. The pro-pygidium is similar in both sexes, while the pygidium differs in shape in the male and female. The former is a transverse structure divided into three areas of which the two lateral ones are similar rectangles with bristles on them, the middle area being a grooved trapezium without any bristles. The pygidium in the female is triangular and directed posteriorly (Plate IV, figs 43, 44, 45 and 46) making an acute angle with the seventh sternite. On the other hand, the pygidium in the male (Plate IV, figs 47, 48 and 49) is shorter, rounded posteriorly and perpendicular to the pro-pygidium — the posterior edge being directed ventrally and is close to the posterior edge of the seventh sternite.

Vestiture : (a) On the first and sixth tergites and also on the epipleurites of the first six segments there are numerous papillae directed posteriorly and laterally in the first and sixth tergites and posteriorly in the epipleurites (Plate IV, fig. 43). They are Y-shaped and are so crowded in the sixth

tergum, that they give a striated appearance. A few of them are also found on the tergites 2-5 and they are crowded on the anterior part of the pro-pygidium. They have a light greenish colour.

(b) There are a few, short and stout bristles on the chitinised areas. They are nearly vertical and moderately chitinised. These are not represented in the figure.

(c) On the pro-pygidium there are short bristles arising from a trough-like chitinisation in the posterior half of the rectangular areas (Plate IV, fig. 43).

(d) The most prominent bristles are found on the pygidium. They have narrow bases arising from rounded chitinisations and they are directed posteriorly.

The Pleurites

On the segments 1-6 the epipleural region shows no definite demarcation from the tergites. This region is membranous and on it are situated the abdominal spiracles. These will be described in connection with the respiratory system. The seventh pleurite, in contrast with the preceding ones, is highly chitinised and is not easily distinguished from the pro-pygidium. The epipleurites are shown in Plate IV, fig. 43. The hypopleurites (Plate I, fig. 1) lie below the pleural suture. There are seven hypopleurites of which the first is scarcely distinct from the second. The third to sixth hypopleurites are oblong, while the seventh is triangular. Hypopleurites are, in contrast to the epipleurites, chitinised and well marked from the sternites.

Sternites : In both sexes there are seven external sternites (Plate IV, fig. 50) of which the first two, hidden by the large metacoxa (Plate I, fig. 1) are much less chitinised than the rest of the sternites. The area representing the first sternite is membranous and both segments are without any pubescence. The exposed sternites are equally chitinised and clothed with whitish bristles. The seventh sternite differs in the male and the female (Plate IV, figs 44-49). It is triangular in the female making an acute angle with the pygidium; whereas in the male it is a transverse strucure, much bent laterally. Its posterior edge is in contact with the posterior and lateral edges of the pygidium which in a lateral view is parallel to it. There is also an internal chitinous band along the posterior edge of the seventh sternite in the male (Plate IV, fig. 50). This is not represented in the female. As the seventh sternite is much bent in the male this makes the sixth sternite different in shape from the corresponding one in the female.

The *internal sternites and tergites :* The eighth, ninth and tenth sternites and terga are internal and differ much in size and shape in the sexes. It is relatively easy to interpret these segments in the male in which the pygidium appears to be the seventh tergite. Inside the seventh segment there

is a complete segment. The eighth sternite is a small transverse structure covered on both sides and along the posterior edge with numerous hairs (Plate V, fig. 51). It lies under the eighth tergite which projects beyond it on all sides. The eighth tergite is membranous. The only chitinisation in the eighth tergite is on its strong lateral margins which extend posteriorly and probably represent pleurites. The rectum opens beneath this tergite. The spicule which is said by Hopkins to represent the ninth sternite is attached to the eighth sternite by its posterior fork (Plate V, figs 51 and 52). It lies under the median plate of the genitalia and functions as an apodeme for the retractile muscles of this plate.

As the above interpretation fits the male, the pygidium in the female should also be the seventh tergite. Posterior to the female pygidium there is a tube through the narrow posterior opening of which project the anal tube and the ovipositor (Plate V, figs 53 and 54). This tube may represent the ninth sternite and tergite. This would place the genital opening very far back, and on this supposition the eighth segment and tergite have disappeared. The sternal side of the tube is much chitinised along the median line but the rest is membranous. There are several hairs on both sides and above the posterior margin. The tergal side shows a slight chitinisation and is membranous along the median line. Laterally, the pleural areas are membranous. A membrane is folded inside the narrow posterior end of the tube and is evaginated when the ovipositor is exserted. The tube has no definite limit anteriorly as the membrane is irregular.

The anal tube represents the tenth sternite and tergite. On its sides there are two elongated supports. These are highly chitinised while the rest of the tube is membranous. The tube is internally attached to the outer tube representing the ninth sternite and tergite by a membrane. The rectum opens at the narrow posterior end of the tube.

Genitalia

The *male genitalia* lie below the gut. As shown in Plate VI, figure 76, it begins anteriorly with a mass of muscles which takes the form of a loop on one side of the ejaculatory duct. The muscles extend dorsally along the median struts and ventro-laterally along the tegmen.

The elements of the male genitalia are represented in Plate V, fig. 57.

(1) The median plate is termed by Hopkins the « body » and according to him represents the tenth sternite. The median lobes constitute the posterior part of the median plate and are termed the « lateral folds » by Hopkins. The dorsal lobe is continuous with the median struts and is broader than the ventral one which is more pointed and projects beyond it. The median orifice is enclosed between the two lobes and through which the ejaculatory duct, the « internal sac » of Sharp and Muir, is evaginated. The median

struts, the « femora » of Hopkins, are prolongations from the dorsal lobe and serve for the attachment of the retractile muscles.

(2) The tegmen is much shorter than the median plate and lies laterally with its central part encircling the median lobes (Plate V, figs 57 and 58). Its posterior end is grooved ventrally (Plate V, figs 58 and 60) and has about five hairs directed posteriorly and several lateral bristles. Dorsally (Plate V, fig. 59), there are several short, stout hairs. The whole surface of the posterior end is covered with short fine pubescence or papillae. The anterior part of the tegmen is a single strut or apodeme for the attachment of the muscles by which the median plate is extended according to Hopkins. The tegmen is supposed by Hopkins to represent the ninth tergit. This can scarcely be the case in *Araeccrus fasciculatus* De Geer where the ninth tergite is well marked (Plate V, figs 51 and 52) and moreover, it is usually held that no abdominal tergites or sternites enter into the formation of the genitalia.

(3) The spicule (Plate V, figs 51, 52 and 57) is a ventral rod forked posteriorly where it joins the eighth sternite, and according to Hopkins, it represents the ninth sternite. It is not a part of the aedeagus, but it serves as an apodeme for the attachment of the retractile muscles of the median plate.

The *female genitalia* (Plate V, figs 55 and 56) is simple but much specialised. It consists of a strong but a prominent ovipositor with the vaginal tube on its ventral side. At the posterior end of the ovipositor there is a pair of styli and these are highly chitinised. Each of them bears two long bristles on the inner side and three short spines on the outer side The « spines » (Plate V, figs 55 SP and 56 SP) are really a short « genital polpus », as in other Anthribids, Cerambycids, etc.. Each stylus has three teeth — a prominent, acute apical one and another smaller, sub-apical, and a third lateral one.

The coxites are a pair of elongated structures, joined together in the middle line and extending anteriorly as three apodemes for almost the entire length of the abdomen. These are two lateral and one median and they serve for the attachment of muscles which control the movement of the ovipositor. The muscles are attached anteriorly to the median part of the anterior apodeme of the metatergite and in front of the median groove.

4. Internal anatomy

The alimentary canal

The alimentary canal (Plate V, fig. 61) is a tubular structure and it runs from the mouth straight into the head and prothoracic regions, but it is slightly curved to the left side of the insect in the metathorax. It is twisted on itself in the anterior region of the abdomen ; then it turns anticlockwise,

proceeding anteriorly and then posteriorly again making a loop in the anterior part of the hind gut. Finally, it continues in a straight line to the end of the rectum. The alimentary canal in *Araecerus fasciculatus* De Geer has the usual three definite regions — the fore, mid and hind intestines. The *fore-intestine* or fore-gut is situated in the head region, the proventriculus being at the posterior end of it. It consists of the pharynx, œsophagus, crop and gizzard or proventriculus. Although it begins with the mouth, there is no special mouth region and it is only indicated by the labrum dorsally, the labium ventrally and the mandibles and maxillae laterally. The pharynx (Plate V, figs 62, 63 and 64) consists of two folds, a dorsal one that proceeds from the internal epistomal region and extends laterally to the lateral arms of the epistoma (Plate V, fig. 63) ; and a ventral fold that extends from the posterior end of the hypostoma (Plate V, fig. 64). Both folds have pharyngeal papillae on their anterior surfaces and these become less laterally. They are directed towards the median line in the ventral fold but are less regular in the dorsal one. The ventral area of the pharynx is supported by two chitinised longitudinal rods which are elongations of the posterior edge of the hypostoma. Perpendicular to these, there is a transverse chitinisation which runs laterally for a short distance and marks the beginning of the œsophageal region.

The œsophagus is a straight tube narrowed posteriorly where it leads to the crop region without any marked demarcation between the two.

The gizzard or proventriculus is a large rounded structure, lying at the posterior end of the head and externally appears brown in colour owing to the denticles inside. In a transverse section (Plate V, fig. 65), it is octagonal in shape with very long denticles arising from the thick chitinous layer lining it. The denticles appear to be long and crowded in the angles of the octagon, short and few on the sides. The epithelium lies outside the chitinised layer and is followed by a thick band of four circular muscles. Outside these lie longitudinal muscles.

A longitudinal section (Plate V, fig. 66) shows the chitinous lining in close contact with the mesentron of the mid-gut posteriorly and with the chitinous lining of the fore-gut anteriorly. In contrast to the epithelium and circular muscles of the gizzard, those of the fore-gut consist of narrow bands.

The *mid intestine* begins from the posterior region of the gizzard and ends where the malpighian tubes arise. Histologically, it shows the following structures (Plate V, fig. 67) :

(a) It is lined internally by elongated cells forming the enteric epithelium. These cells have narrow bases and their inner margins are not well defined. Granular protrusions extend from the epithelial cells to the lumen of the stomach. Some of the epithelial cells are only seen as a group of nuclei and these are regenerative cells occurring only in the tubercular areas.

(b) The epithelium cells rest on a very thin basement membrane.

(c) The basement membrane is followed by longitudinal muscles.

(d) The peritoneal membrane is the outermost layer.

The *hind intestine* begins with four malpighian tubes. These are inserted in a whorl and are evenly spaced round the gut. They are very long and extend to the prothorax and turn back to the loop of the hind intestine to which the narrow ends of the tubes are in close contact. The anterior part of the hind gut forms a loop which in the male lies over the anterior part of the genitalia and in the female, over the apodemes of the ovipositor. The two arms of the loop are parallel to each other and are of small diameter. They represent the ilium and a part of the colon regions.

Histologically, the ilium of the adult of *Araecerus fasciulatus* De Geer (Plate VI, fig. 68) consists of a thick chitinised inner layer, the intima which makes a lining for six large epithelial cells. Each of these is a twin cell with two nuclei but without any definite cell wall between them. These are bounded by one layer of circular muscles, followed by six bands of longitudinal muscles, lying between the epithelial cells. The four malpighian tubes surround the ilium and outside these lie a peritoneal layer. Posteriorly, the histology of the hind gut changes considerably. In the colon region, the intima becomes thicker making pockets on one side but being straight on the other. There are two definite chitinous strands, one on each side. The intima is surrounded by epithelial cells but these are different in shape and arrangement (Plate VI, fig. 69). On one side of the colon lie several layers of circular muscles; while on the other lie the malpighian tubes which become grouped together. A peritoneal layer surrounds the malpighian tubes and the circular muscles. The rectum is swollen anteriorly where it has two lateral, chitinous U-shaped strands. It thins out posteriorly until it opens under the ninth tergite in the male. It is surrounded by the anal tube in the female and this as well as the ovipositor are surrounded by the tube representing the ninth sternite and tergite, as already mentioned.

As shown in Plate VI, figure 70, the rectum is surrounded with circular muscles and thus differs from the two preceding regions of the hind gut. The intima is very thick and its inner surface is much constricted. Between the intima and the circular muscles, the epithelium is found mostly in pockets. The epithelium cells in the ilium are very different from those of the colon and rectum (Plate VI, figs 68, 69 and 70).

The nervous system

The nervous system of the adult is very much specialised; the number of ganglia being much less than that of the thoracic and abdominal segments. It is more developed in the head and thorax than in the abdomen, as shown in Plate VI, figure 71.

The nervous system of the head is represented by the brain and the sub-œsophageal ganglion. The brain is well developed occupying a large area in the centre of the head and between the eyes. Dorsally, the brain is covered by a cortex and when this is removed, it is found that the protocerebral lobes are very prominent and occupy the median section of the brain. On either side of these, there is the optic lobe, divided into two parts, of which the outer one is smaller. Its end which lies at the base of the eye, is of a violet red colour, caused by the inner ends of the ommatidia and probably represents the periopticon or the ganglionic layer. The part on either side of the protocerebral lobes is the opticon or the internal medullary mass. From the antero-ventral aspect of the brain the deutocerebrum arises as paired swellings from the protocerebral lobes and gives rise to the antennary nerves. The tritocerebral ganglia are paired swellings on the protocebrum and lie between the deutocerebrum or the antennary ganglia. They give rise to the labral nerves which are more prominent than the antennary ones. Laterally (Plate VI, fig. 72) the brain is joined to the sub-oesophageal ganglion by a broad commissure known as the «para-oesophageal connectives». The sub-oesophageal ganglion is the ventral ganglionic centre in the head and lies under the oesophagus. It is triangular in shape and from its antero-ventral part three nerves extend on each side to the mandible, maxilla and labium.

The ventral nervous system of the thorax is represented mainly by two ganglia. The first lies in the prothorax and is connected to the sub-oesophageal ganglion by a long commissure, most of which lies in the head. The first thoracic ganglion is triangular in shape when viewed laterally and has one apex directed ventrally. The nerves arising from it innervate the fore-legs. The second ganglion is very prominent, broad anteriorly and narrowed posteriorly. It lies in both the meso- and metathorax. It has three main nerves on either side and innervates the mid and hind legs. The third ganglion of the ventral nervous system is very small and lies over the sternellar piece of the metathorax. Two main nerves extend from it to the abdomen. Hence, this ganglion could be considered common between the thorax and abdomen The last ganglion is large and lies mostly in the fourth abdominal segment. It appears to represent two ganglia in some individuals. Several nerves arise from its posterior end and innervate the reproductive organs and the hind gut.

Reproductive organs

The *female reproductive organs* are situated ventrally below the gut and the ovipositor. The latter lies over the central portion of the reproductive organs. They are comprised (Plate VI, fig. 73) of the ovarioles and their terminal chambers, paired oviducts, unpaired oviduct or uterus, bursa copulatrix, spermatheca with its duct and gland, and lastly the vagina. There are five ovarioles on each side of the ovary in which the eggs are disposed in a

chain with the oldest cocytes near the unpaired oviducts. There are three well marked zones for every ovariole :

(a) The terminal filament which lies anteriorly and unites with the filaments of the other ovarioles and form a common thread which supports the ovarioles.

(b) The germarium or the terminal chamber which is an elongated structure of granular nature and lies below the filament. From it, small oocytes are budded off and move to the oviduct where they mature.

(c) The vitellarium is the region containing the developing eggs and constitutes the major part of the ovariole. This portion does not exist in the newly emerged adult (Plate VI, fig. 74). It begins to develop three days after emergence.

There are two oviducts leading from the ovaries and they unite posteriorly into a common duct or uterus; and this has a larger diameter than either of the paired ducts. Although the paired ducts are narrow, the wall is capable of much distension as mature eggs of much larger diameter than the ducts are often seen lodged in them. The common duct is not entirely membranous; transverse striations and numerous projections are present (Plate VI, fig. 75).

The bursa copulatrix is a prominent conical structure. It runs obliquely as a diverticulum from the oviduct. Its anterior end is pointed and has strong muscles attached to it. The bursa copulatric is thick walled and has two lateral chitinisations on the inner side.

The spermatheca is a kidney-shaped structure, small, chitinised and thick-walled. Attached to it externally there is the spermathecal gland. Also there is a spermathecal duct which runs from one end of the spermatheca to the angle between the bursa copulatrix and the uterus.

The vagina narrows posteriorly and runs below the ovipositor and is enclosed by the membrane that underlies the posterior part of the ovipositor (Plate V, fig. 60).

The *male reproductive organs* (Plate VI, fig. 76) occupy the same position as those of the female. The testes lie ventrally on either side of the gut and are kept in position by the surrounding fat bodies and tracheae. The accessory glands are convoluted in the body cavity. There is a pair of testes on each side. These are somewhat rounded and have seven or eight lobes when mature. They are not always uniform in shape and size. A vas deferens arises ventrally from each of the four testes. These run posteriorly, and join to form a pair of single ducts, the anterior parts of which are greatly enlarged. The main vas deferens of each side ends medially in the vesicula seminalis, the surface of which is many-lobed. On either side of it, a pair of accessory glands of considerable diameter arise. Also, a narrow, common seminal outlet or tube leads posteriorly to the ejaculatory duct. The junction of this tube with the vesicula seminalis is paired at the base, probably suggesting that the vesicula

seminalis was also paired originally. The junction of the seminal tube with the ejaculatory duct is surrounded by strong muscles.

The ejaculatory duct (Plate V, fig. 57; Plate VI, fig 76) is large and narrows out posteriorly where it ends between the dorsal and ventral lobes of the median plate. At its anterior end, there is a prominent armature of denticles and papillae. The denticles are five. There are two lateral, hook-like structures, highly chitinised and their chitinisation becomes less as they proceed anteriorly. In the median section of the dorsal wall of the duct is a pair of oblique denticles making an acute angle with the inner surface. Between these and the hook-like denticles. there is a median transverse plate lying vertically on the inner wall of the duct. The papillae are not uniform in this region and they occupy a much greater area than the denticles. Some of them are V-shaped, others are elongated and some are slightly rounded. When the ejaculatory duct is everted during fertilization, this region is inserted into the female, while the major part of the duct is not introduced. The base of this part of the ejaculatory duct which is exserted during fertilization is supported by the dorsal and ventral lobes of the median plate which maintain their relative position (during fertilization). The tube is supported ventrally by the end of the tegmen. The rest of the tegmen (the basal piece) as well as the median struts and the spicule remain internal.

The circulatory system

The circulatory system consists of the heart and the dorsal aorta. It occupies the median, dorsal line of the body-cavity and extends from the seventh abdominal tergite or propygidium as far as the brain. The heart is the posterior part of the circulatory system and it has six chambers. It lies beween the longitudinal muscles on the ventral side of the second to seventh abdominal tergites. The relative position of the chambers does not coincide with that of the corresponding tergites (Plate VI, fig. 77). Every chamber lies in two tergites. The chambers are narrowed as they proceed posteriorly. The posterior chamber is comparatively small and lies mostly under the propygidium. The heart is a colourless, membranous, flattened tube. Its wall is muscular and encloses scattered nuclei (Plate VI, fig. 78; Plate VII, fig. 79); where these occur, the wall is somewhat enlarged. It is surrounded by a pericardial membrane with small pericardial cells. Outside the wall of the heart, there are larger «pericardial nephrocytes» which in contrast to the fat bodies are not vacuolated. On either side of the heart, there are alary muscles, attaching the heart to the tergites. On both sides of the heart fat bodies are regularly arranged.

The dorsal aorta runs from the second abdominal tergite to the head. It is much enlarged behind and it thins out as it extends anteriorly. Its posterior part in the first and second abdominal tergites is close to the integu-

ment, whereas, in the meso- and metathorax it lies under the longitudinal muscles. It has a double wall as in the heart and it is easier to dissect for it has no fat bodies round it.

The respiratory system

There are nine spiracles in the adult, two of which are in the thorax and the rest in the abdomen as illustrated in Plate VII, figure 80. The first thoracic spiracle lies laterally in the membrane that joins the prothorax to the mesothorax. The spiracles themselves are lodged in the prothorax and lie anterior to the lateral areas on either side of the posterior declivity (Plate II, fig. 21). The second thoracic spiracle is situated laterally between the meso- and metatergites. The thoracic spiracles are larger than the abdominal ones except the first abdominal. There are seven spiracles in the abdomen of which the first is very prominent, while the last which is situated in the propygidium is very small (Plate I, fig. 1; Plate IV, fig. 43; Plate VI, fig. 77; Plate VII, fig. 80). The spiracles in between are of equal size and equidistant from each other. All the spiracles lie in the epipleural area which is membranous, except in the seventh segment where it is chitinous and fused with the propygidium (Plate VI, fig. 77).

There are two lateral trunks in the meso- and metathorax and in the abdomen, one on either side. The trunks are only doubled in the prothorax and the head, where there is a dorsal and ventral trunk on both sides. The second thoracic spiracle does not lie on the main course of the lateral trunks.

The *tracheal system of the head :* The dorsal trunk of the prothorax runs to the posterior part of the head and from the transverse connection joining the two dorsal tracheae, a median one runs perpendicularly above the fore-gut and bifurcates anteriorly into two main tracheae which branch in turn into smaller ones running into the muscles and the mouth parts. Very fine tracheae are seen in contact with the brain. The ventral tracheal system is a continuation of the ventral trunk of the prothorax which extends into the head with a cross or a transverse connection under the oesophagus. Anteriorly, the trunks bifurcate and each trachea branches in turn into smaller treacheae which run into the muscles, sub-oesophageal ganglion and the mouth parts.

The *tracheal system of the thorax :* The dorsal and ventral trunks of the prothorax begin their course from the first thoracic spiracle. They run obliquely to the head. The ventral trunk is straighter and from it lateral tracheae branch into the muscles. The branches of the dorsal tracheae run into the central part of the prothorax and are in contact with the dorsal muscles and the gut. Besides these two trunks, two other tracheae run from the spiracle and branch in the muscles laterally.

The tracheal system of the mesothorax is represented mainly by the lateral

trunks which are short and nearly ventral. Three tracheae arise from the second thoracic spiracle, of which the anterior one gives rise to the tracheal system of the elytra.

The tracheal system of the metathorax is represented by the main lateral trunks which run into the lateral muscles. From the trunks the trachaea branch into the longitudinal and lateral muscles. From the first abdominal spiracle arises a large trachea, the basal part of which can be seen through the dorsal integument. It has three branches running into the lateral muscles of the metatergum, the hind wing and the metapleurite.

The *abdominal tracheal system* differs from the thoracic one in having a regular distribution. The dorsal system consists of very fine tracheae arising from the spiracles and running across the longitudinal muscles of the abdomen. The tracheae bifurcate along the median part of the tergites and on both sides of the heart. The ventral tracheae are more prominent and branch a great deal into the muscles, the gut and the reproductive organs. In each segment they all originate from a main trachea coming directly from the spiracle of that segment (Plate VII, fig. 80). Only the bases of these tracheae are shown in the diagram.

D. MORPHOLOGY OF THE EARLY STAGES

1. The Egg

The egg (Plate VII, fig. 81) when first laid is transparent white, glistening, usually ovoid in shape, in few cases elongated and cylindrical with both poles similar, or very short with broadened ends. The average length of the egg is 0.565 mm. and the width is 0.323 mm. Twenty-five eggs were measured. The surface of the egg is not smooth but covered with small, rounded pits and these are irregularly arranged. The empty egg shell is quite colourless and very transparent.

The eggs of *Araecerus fasciculatus* De Geer are supposed to have been first described by Swezey (1920-1921). He mentions that they are short, cylindrical, deposited in masses of 40-60 eggs adhering together and are 0.8 mm. long and 0.4 mm. broad. Moreover, he describes the surface of the egg as covered with pits arranged in longitudinal rows. Also he mentions that the eggs become yellow before hatching and that the empty egg shell is pure white.

It will appear later that the maximum rate of egg-laying is never more than 6.7 eggs per day (for a female that has been kept from pairing for three weeks), and that under normal conditions the average rate is much less than that. The eggs of *Araecerus fasciculatus* De Geer are laid singly and never seen adhering together or even in close contact with each other. Consequently, the writer is fully convinced that Swezey was under some mis-

apprehension ; the eggs he describes cannot have been those of *Araecerus fasciculatus* De Geer.

The length of the egg measured by Autori (1931), namely 0.59 to 0.62 mm. and the breadth measured by Cotton (1921) (0.35 mm.) are greater than the writer's measurements. Autuori has described the shape as elliptical and becoming «less spherical» later on.

In the writer's experiments the eggs were laid in the grains of the ordinary Indian maize, usually, in the endosperm which is soft and fleshy or in the powdery part that lies beneath it. They are never laid in the «scutellum» or the hard part of the grain. In most cases, they are found 3-4 mm. deep, although sometimes they are near the surface. In cacao they are found mostly in the crevices or wrinkles of the cotyledon, whereas in nutmeg their position is not limited except that they are usually not deep. One can in most cases distinguish the ordinary feeding bite of the mandibles from the boring of the ovipositor. There is always a very fine dust on the surface indicating the position of the hole made by the ovipositor even if the hole had been obliterated. The fine particles in the case of maize are white in colour lacking the dull appearance of the endosperm.

2. Hatching mechanism

There is no special hatching mechanism for the egg One day before hatching, the mandibles of the first stage larva appear as two red spots at the cephalic pole of the egg. The larva bites its way through the chorion by its mandibles. Eclosion is also effected by its wriggling inside the shell. After hatching the first stage larva remains within the open shell for a few hours; in some cases this period is prolonged to nearly 20 hours.

3. The larval moults

The larval moults are first referred to by Cotton. He states that they are five, but there is no reference to temperature, humidity or food. The writer finds, however, that the number of moults is variable at 90% relative humidity on maize. In most cases, it is four and rarely three or five. Out of 22 larvae, 17 had four instars, 3 had three instars and 2 had five instars. Both sexes were represented in the three cases.

Usually, the first instar takes 5-7 days and the second has a shorter period. The third instar is usually about the same as the first one, while the fourth is variable. When there are only three instars, the periods of the three instars are about 7, 15 and 10 days respectively. In this case, the second instar is about twice as much as the first. When the larva has five instars the first and second instars are about equal to those of the four instars larva, the third nearly as the first two instars combined, while the fifth is about as much as the third and fourth combined.

The data for the three and five instars larvae are not reliable as the number of these larvae is very small. in all cases Dyar's law, namely, the head-width of the larva follows regular geometrical progression in successive instars, does not hold good in the larva of *Araecerus fasciculatus* De Geer.

4. External anatomy of the larva

According to Boving and Craighead (1931) the larva *Araecerus fasciculatus* De Geer is of the *Byrrhidae* type of the Polyphaga — a much less primitive type when compared with the other two, namely. *Staphylinidae* and *Cucujidae*, the former being the most primitive.

The mature larva is 5-6 mm. long. Its body (Plate VII, fig. 82) is curved and wrinkled with the thoracic region enlarged and the head comparatively small. It is whitish in colour. The thorax is nearly one third as long as the abdomen. The prothorax is much broader than the head which merges into it ventrally. The larva is legless except for the presence of semi-globular pedal lobes or large thoracic swellings which are more prominent in the pro- and mesothorax. It is strange that Lucas (1861) described *Araecerus fasciculatus* De Geer larvae as having well developed legs. Swezey (1920-1921) also states that the larva has legs. The tergal, sternal and pleural divisions are well represented in the thorax and the abdomen. The tergal divisions are broad and occupy half the circumference. There are three thoracic and ten abdominal segments, of which the last is tucked into the preceding segment. The divisions and wrinkles of the abdominal segments are not represented in the last two segments which are without spiracles. The body is fairly well covered with fine hairs which are found mostly in groups and are more numerous on the ventral side of the thorax.

The Head

The head (Plate VII, figs 83, 84 and 85) is rounded in shape, longer than broad (in the ratio 7 : 5). It is almost a pale straw colour except directly after moulting when it is white. The mouth parts, especially the mandibles and their articulations, also the epistoma and to a less extent the frontal area and the antero-lateral margins are much darker in colour than the rest of the head.

The primary elements in the adult head are well represented in that of the larva except that the clypeus is well defined in the larva.

In all the larval instars, the head is as broad as the distance between the epistoma and the base of the epicranium. The epicranial suture is twice as long as the epistoma ; it is lighter in colour than the rest of the epicranium. Cotton describes « two longitudinal, light stripes, rising from the frontal sutures and running to the base of the head ». In the writer's opinion these

« stripes » are only dorsal tracheae and could not be seen in boiled specimens They are not quite straight and branch into fine tracheae.

Mouth parts

The *labrum* (Plate VII, fig. 86) is a prominent, pentagonal structure with two posterior arms. It is broader than long and has the anterior margin lobed. It is much more chitinised than the clypeus. Its vestiture is more symmetrically arranged than in the adult. Dorsally, there are four pairs of long hairs, three of them are antero-lateral, while the fourth lies on the median line anteriorly. On the ventral or epipharyngeal side, there are two pairs of short, thick bristles, between which two or three fine bristles can be seen (in some specimens more clearly than others). Anteriorly, there are two fine bristles. Also, there are a few papillae along the margin ; these are not clear in some specimens. Anthuori describes « four hairs in the median section of the upper side and one on each side near the external angle ». The labrum is attached to the clypeus by a membrane. Posteriorly, its arms, known as the epipharyngeal rods, are attached by muscles to the roof of the mouth.

The *mandibles* (Plate VII, 87 and 89) are stout, triangular and tridentate. The apex is produced into an acute, apical tooth. On the inner edge below the apical tooth, is the sub-apical one, followed by the median tooth. The rest of the inner margin is the molar surface which is slightly grooved or depressed anteriorly. Dorsally, there are two long bristles of unequal length. The dorsal articulation is through a condyle at the lateral end of the epistoma (Plate VII, figs 84 and 86) fitting into a fossa on the mandible. In the ventral articulation (Plate VII, fig. 89), the condyle is borne by the mandible itself and fits into a fossa close to the termination of the hypopharyngeal bracon The large adductor muscle lies at the base of the molar surface, whereas the small abductor is attached to the outer, basal angle.

The *maxillae* (Plate VII, figs 85 and 88) are narrow, elongated structures lying on both sides of the labium and fused with it. The cardo is quite distinct and slipper-like. Its posterior end is much narrowed and attached by a ligament to a small, triangular condyle on the lateral ends of the tentorial bridge. Anteriorly, the cardo is attached to the base of the stipes by a membrane. Cotton refers to « a stout chitinised seta on palpifer just below the maxillary lobe ». The palpifer, an outer lateral sclerite borne by the stipes, does not seem to occur in the larva of *Araecerus fasciculatus* De Geer. The inner margin is produced into a well chitinised. distinct spine, which represents a lacinial lobe and it is to this, probably, that Cotton is referring. This lacinial tooth is far from the region where the palpifer would occur. The outer side of the maxillae is terminated by a two-segmented palpus and is telescopic. The basal segment is thick and partly buried in the stipes. The distal segment is narrow and has papillae on its end. Between

the maxillary palp and the lacinial spine, there is a lobe with strong bristles on its inner margin. Similar bristles are found at the base of the lacinial spine. There are about twenty long hairs scattered on the stipes especially on its outer margin, but none are found on the inner margin.

The *labium* (Plate VII, fig. 85; Plate VIII, figs 90 and 91) is a broad, transverse structure, lying between the inner margins of the maxillae and fused with them. Its form is quite different from that of the adult. The sub-mentum is very broad and is directly connected posteriorly with the sternal region of the prothorax. It is also directly connected with the cardo, and by a lateral lobe on each side, with the stipes. The mentum is rounded and convex. It forms with the pre-mentum a dome-like structure. There is no definite suture between the mentum and the sub-mentum as indicated by Cotton. Each of the labial palpi has one well-defined segment fused at its base with the pre-mentum. Cotton has described the palpi as two-segmented, but the writer can find nothing to suggest this. However, his figure of the labium does not show clearly two-segmented palpi. Autuori (1931) also describes two segments and states that they are of equal length. Gardner (1932) in his « Immature stages of Indian Coleoptera: Anthribidae » describes the labial palps of *Araecerus suturalis* Boh. as one-segmented and suggests that the basal segment referred to by Cotton in his description to the labium of the larva of *Araecerus fasciculatus* De Geer is fused with the pre-mentum.

Anterior to the pre-mentum and ventrally, lie the fused ligula and hypopharynx. Their anterior edge is lobed, and has several setae (Plate VIII, fig. 90). Laterally, there are numerous, acute papillae, becoming larger towards the median line. In the pre-mentum there are three hairs on each side — two of them behind the palpus and one at the base. In the mentum there are two long hairs — one on each side, arising posteriorly. The submentum bears a pair of long median hairs and about 16 hairs on its lateral articulation with the stipes. These are not usually « four groups of four each end » as Cotton states, but rather three anteriorly and five posteriorly. Besides these hairs on the lateral sides of the sub-mentum, there are several acute papillae on the anterior end. Behind the hypopharyngeal region (Plate VII, figs 84 and 89; Plate VIII, fig. 90) there is a strong chitinisation known by Boving and Craighead as the « hypopharyngeal sclerome ». This is not uniformly chitinised, its medium section being more chitinised than the lateral angles. The sclerome is continued laterally on both sides by what is known as the « hypopharyngeal bracon » which ends at the epicranium close to the ventral articulation of the mandible. The hypopharyngeal chitinisation is forked into two processes which in the natural position are directed anteriorly (Plate VII, fig. 84). Between the strong chitinisation of the sclerome and the processes there is a cavity. The processes function as apodemes for supporting the pharyngeal muscles.

The *clypeus* (Plate VII, fig. 86) is an oblong, membranous structure. It is twice as broad as long and pre-epistomal in position. It is as broad as the labrum and its anterior margin overlaps the posterior one of the latter. The basal margin of the clypeus is rigidly connected to the epistoma. The sides are nearly straight with the anterior angles slightly obtuse; the basal angles being acute and produced towards the dorsal articulation of the mandible.

The *epistoma* (Plate VII, figs 84 and 86) is a narrow, transverse, chitinised area at the base of the clypeus and extends laterally to the dorsal condyle which fits into the dorsal fossa of the mandible. Its chitinisation is not uniform, being greater at the dorsal condyle. Internally, its median part at the base of the clypeus ends in two projections or processes which serve for the attachment of the pharyngeal muscles. They are more chitinised than the central area.

The *front* is posterior to the epistoma and is not marked off as the frontal sutures are very short.

The *epicranium* is represented by the large dorsal lobes on either sides of the epicranial suture; these merge into the occipital and genal areas.

The *occipital foramen* (Plate VII, fig. 85) lies in the ventral and posterior part of the head. It is very large compared with that of the adult. It is bounded laterally by a broad tentorial rim which narrows as it extends posteriorly. Anteriorly, it is limited by the tentorial bridge which forms the anterior part of the endoskeleton. The occipital apodeme lies beneath the posterior end of the epicranial suture.

The *thoracic and abdominal tergites, sternites and pleurites:* The pronotum (Plate VIII, fig. 92) is not divided; but the meso- and metathoracic terga show two dorsal divisions and a short lateral one extending to the alar area where the mesothoracic spiracle is located. The regular arrangement of the wrinkles in the thorax and abdomen has led Cotton, Hopkins and others to give these the same names adopted for the divisions of the thorax and abdomen of the adult. The writer does not share this view for two main reasons. The first is that these divisions are not marked by definite sutures as in the adult. The second is that it is hard to trace any homology between these divisions and those of the adult unless a further study is made to find a relationship between the larval and pupal segments on one hand and the pupal and adult segments on the other. It appears, therefore, perhaps better to use the terms, « alar area » where spiracles are located, « coxal lobe » where legs would arise if they were present, « epipleuron and hypopleuron » for the two tubercles between the alar area and the coxal lobe, and « eusternum » for the ventral areas of the thorax and abdomen. These terms are only used on account of their relative positions and to make the systematic description possible. As to the tergal divisions, it seems better to avoid the terms used in the adult.

The tergum in the abdomen (Plate VIII, fig. 93) consists of two transverse lobes or divisions. The first, or anterior division is characterised by the presence of short, contiguous tubercles, arranged regularly, one beside the other, and clear only on the first five abdominal tergites. After that, they become obscure and do not exist on the last three segments. They are similar to those of *Araecerus suturalis* Boh. described by Gardner (1932). Besides the two tergal divisions of the abdomen, there is a short, triangular, lateral one which merges into the alar area. According to Cotton, all the tergal divisions of the adult are represented in the thorax and abdomen of the larva of *Araecerus fasciculatus* De Geer. He maintains that the « scutum » and « scutellum » are fused in the meso- and metathorax. The lateral aspect of the abdomen clearly shows three lobes, two triangular ones and a slightly elongated one between them. These may represent the epipleural, hypopleural and coxal lobes. Ventrally, between the coxal lobes of each side, the eusternum stretches undivided.

The number and arrangement of the tergal divisions in the meso- and metathorax is similar to those of the abdomen (Plate VIII, fig. 93). The lobe representing the hypopleuron in the abdomen is missing in the thorax. There is no alar area in the prothorax and the pleural area is represented by a large lobe on either side of the pronotum and a very small one behind it.

5. Internal anatomy of the larva

Alimentary canal

The alimentary canal (Plate VIII, fig. 94) is a tube actually longer than the body of the larva and much coiled in the abdominal region. The fore-gut is straight and narrow when compared with the mid-gut. It begins with the mouth region, marked by the labrum above and the labium below. Internally, there is the epipharynx lining the labrum and the hypopharyngeal region which is fused with the ligula. The œsophagus runs posteriorly between the anterior fork or processes of the hypopharyngeal chitinisation (Plate VII, fig. 89). Its posterior end is slightly enlarged and represents the crop area. The gizzard, unlike that of the adult, is not well defined and does not show any marked chitinisation. It lies in the prothorax, whereas the gizzard of the adult lies at the posterior end of the head. There are two long salivary glands, one on either side, opening ventrally on each side of the labium. Each has a narrow, central duct and is lobed on both sides except at its base which is pressed to the oesophagus.

The mid-gut starts in the mesothorax and is dull white in colour, in contrast to the clear, transparent fore-gut. It is coiled as in the figure and ends where the four malpighian tubes originate. These are found in a whorl and are equally spaced around the gut. They are more translucent in colour than those of the adult.

The hind-gut differs from that of the adult in being uniform, differently coiled, and without external chitinisation.

The nervous system

The ventral nervous system (Plate VIII, fig. 95) forms a long chain which runs along the median, ventral line and can be seen through the skin of the larva. The nervous system of the head is represented by the brain and the sub-oesophageal ganglion. The brain lies over the oesophagus and consists of two triangular lobes with a narrow connection between them. From the anterior part of the brain two main nerves, one on each side, proceed anteriorly and innervate the mouth-parts. The brain and the sub-oesophageal ganglion are connected by para-oesophageal connectives on either side.

The thoracic and abdominal segments nearly all have separate ganglia. In most individuals, the metathoracic and first abdominal ganglia coalesce into one which is usually elongated and constricted. The last two or three ganglia also coalesce into a large, triangular one. The size and shape of the ganglia differ in the mature larvae. They may be rounded and fairly large or narrowed and elongated. The commissures joining the ventral ganglia are clearly in pairs.

The respiratory system

The respiratory system (Plate VIII, fig. 95) consists of two main, lateral trunks, one on either side. There are nine spiracles, one thoracic and eight abdominal ones. The thoracic spiracle lies in the mesothorax and close to the prothorax. Lefroy (Indian Insect Life, 1909 p. 380) mentions *Araecerus fasciculatus* De Geer or one of its allied species as a cotton seed pest. In his illustrations, the thoracic spiracle of the larva is located in the prothorax. If the drawing is accurate, the cotton seed pest must be another insect. Autuori draws the mesothoracic spiracle very close to the metathorax. The illustration of Cotton, Boving and Craighead and the writer's agree as far as the position of the thoracic spiracle is concerned. As shown in Plate VIII, figure 96, the mesothoracic spiracle is biforous, the two openings being directed dorsally. The openings are independent, with no common wall in between. The thoracic spiracle is considerably larger than the abdominal ones. The latter (Plate VIII, fig. 97) are uniforous with their openings directed dorsally.

From every abdominal spiracle four main tracheae arise. These are one dorsal, one ventral and two lateral. The ventral tracheae are very thin and are represented in the figure by a line. They lie over the ventral muscles and branch in their distal ends into fine tracheae which surround the ganglia and the commissures between them. The other three tracheae are about equal in diameter. The dorsal one, runs in the tergal area, while the two lateral ones

run into the body cavity and branch in the fat bodies and round the alimentary canal.

Although there is only one thoracic spiracle, yet the tracheal system in the thorax is well represented. About seven main tracheae arise from the thoracic spiracle. Two of these tracheae proceed to the head. The inner one is ventral and branches into two before it gets to the brain It divides again ventral to the brain. The outer one is dorsal and has several, small branches. It is probably these that Cotton described as « longitudinal streaks » as already mentioned. The other tracheae from the thoracic spiracle run dorsally, ventrally and laterally. The ventral one is not fine as it is in the abdomen. Between the thoracic and the first abdominal spiracle there are four tracheae arising from the main trunk in two places. The ventral one of the metathorax is similar to those of the abdomen, being very fine.

6. The Pupa

Pupation

Just before the pupa is formed, the thorax and abdomen of the larva become of equal length. The abdomen tapers posteriorly. The tips of the wings are sometimes seen protruding through the larval skin at the posterior and lateral ends of the metathorax. Dorsally, the thoracic region is constricted from the abdominal one.

The pupa (Plate VIII, figs 98-101) is from 3.78 mm. to 4.57 mm. long (average = 4.12 mm.) and from 1.92 mm. to 2.37 mm. broad (average = 2.12 mm.). Twenty pupae were measured. Cotton's measurements are from 3.75 to 4 mm. long and 2 mm. wide. Autuori's measurements are 4.57 to 5 mm. for the length and 1.5 to 2 mm. for the width. Lucas overestimates the length (5 mm.) and underestimates the breadth (1.75 mm.). The pupa when first formed is white and translucent with no sign of chitinisation except at the pointed tips of the elytra. These are hook-like reaching the sixth segment of the abdomen. Lucas describes the colour as being testaceous and turning brown when the adult is about to emerge. The first sign of chitinisation appears faintly in the bulla of the eye two days after pupation. This is followed by the darkening of the apical ends of the mandibles which become reddish in colour. The sternites are the last part of the body that become chitinised, becoming so only in the very mature pupae. The head, pronotum, antennae and tarsi are the most heavily chitinised parts in the mature pupa. As a rule, the last larval skin is seen clinging tightly to the last three abdominal segments. This affords a good protection for these segments which are very transparent, even in the mature pupa. In the majority of cases, the pupa dies if the larval skin is removed in the early stages of pupation. The pupa is very active and moves its abdomen quickly in a circular motion. The head (Plate VIII, fig. 99) is bent ventrally and is rounded anteriorly. It is

overlapped dorsally by the anterior part of the prothorax. Lucas describes a longitudinal furrow traversing the head in its median line. The writer could not trace a furrow of any sort on the head. The mouth-parts as a whole are short, broad and lie almost over the sternal area of the prothorax. The labrum is triangular in shape differing from that of the larva and the adult. It is also elongated and covers most of the mandibles. It is not narrowed posteriorly as in the adult but is much broadened, extending nearly to the lateral ends of the epistoma. The ligula and the ends of the maxillary and labial palps are seen protruding beneath the mandibles. The tips of the labial palps are nearly as long as the ligula. Both the labial and maxillary palps are narrowed at their ends and do not show any clear segmentation. The antennae arise anteriorly to the eyes and appear nearly filiform in the newly formed pupae. They are folded over the back with their tips on either side of the rounded end of the meso-scutellum. In the newly formed pupa the segments of the antenna are not clear. The club area shows the segmentation more than the rest of the antenna and in this area chitinisation begins earlier and becomes very deep in the mature pupae. Lucas states that « the antennae are yellowish and lie longitudinally between the prothorax and the fore-legs. The last joints are pressed to the centre of the femora of the mid legs ». The eyes are nearly kidney-shaped and not oval as described by Lucas and Autuori, nor rounded as illustrated by Lefroy. There are several long hairs on the exposed part of the epicranium but none in the frontal area.

The dorsal aspect

The pronotum (Plate VIII, fig. 98) has the same truncated shape as in the adult. It is also bisinuate in its posterior margin. It is the first part of the thorax to show chitinisation, being covered by long, whitish hairs which become brownish later. On the meso-and metaterga there are two groups of hairs. These are more crowded on the mesotergum and are of different lengths. The lateral edges of the median groove show the first chitinisation in the metatergum. As in the adult, the first abdominal tergites are similar; all are narrow, transverse bands. The median dorsal line is clear along them. On both sides of it, there are a few hairs in each segment and there are also hairs on the lateral sides. The seventh tergum is very large and triangular in shape (Plate VIII, figs 98 and 100). It is slightly longer than the seventh and eighth sternites combined. The pro-pygidium and pygidium of the adult are seen in the mature pupa arising under the seventh tergum of the pupa. The demarcation between the seventh and eighth terga is not clear and appears only as a wrinkle. The ninth tergum is very narrow and expands laterally into a triangular process which has two lobes at its distal end. Papillae are found on these processes. The tenth tergite is very small and is tucked into the ninth. The last two segments in Autuori's illustration

of the pupa are not clear. The processes of the ninth segment are lacking in Autuori's figure. There is no reference to them in Lucas's description.

The ventral aspect (Plate VIII, fig. 99)

There are three distinct regions in the legs, namely, the femur, tibia and tarsi. The last do not show any segmentation except where the claws of the adult arise. This segmentation is clearer in the hind leg than either the fore or the mid-leg. The hind leg extends beyond the ends of the elytra and reaches the seventh sternite. The end of the fore-leg reaches the third sternite or the first apparent segment. whereas the mid-leg extends as far as the fourth.

Sternites 3 to 6 are alike, being short and broad. The seventh and eighth are longer and narrower. The ninth sternite is much broader than the ninth tergite.

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TABLES I-VIII

Explanation of Plate I

Fig. 1. — Adult (female), lateral aspect: 1-7 = hypopleurites; A.SC = antennal scrobe; C.C1, C.C2 = coxal cavity of the fore and mid legs respectively; C.T3 = cavity of the articulation of the trochanter of the hind leg; CX1, CX2, CX3 = coxa of fore, mid and hind leg respectively; E = eye; EP = epistoma; EPM = epimeron; EPS = episternum; MES.ST = mesosternum; MET.ST = metasternum; MET.T = metatergum; P = pygidium; PAR = parapterum; PL.S = pleural suture; P.P = propygidium; PR = pronotum; SCL = scutellum of mesonotergum; SP1-SP7 = seven abdominal spiracles; ST3-ST7 = third to seventh sternites; ST.T = ninth sternal and tergal tube; T = trochanter of hind leg; T1-T6 = first to sixth tergite; W.P = wing process. — × 7.5.

Fig. 2. — Head, dorsal aspect: A.SC = antennal scrobe; E = eye; EP = epistoma; E.S = epicranial suture; LB = labrum; LM.P = labial palp; MD = mandible; MX.P = maxillary palp. — × 12.

Fig. 3. — Head, ventral aspect: E = eye; G = genal area; LM.P = labial palp; MD = mandible; MX.P = maxillary palp; O.A = occipital apodeme; O.F = occipital foramen. — × 12.

Fig. 4. — Head, lateral aspect: A.SC = antennal scrobe · E = eye; EP = epistoma; E.S = epicranial suture; LB = labrum; M A = membranous area; MD = mandible; MX.P = maxillary palp; P.G = pregenal area. — × 14.

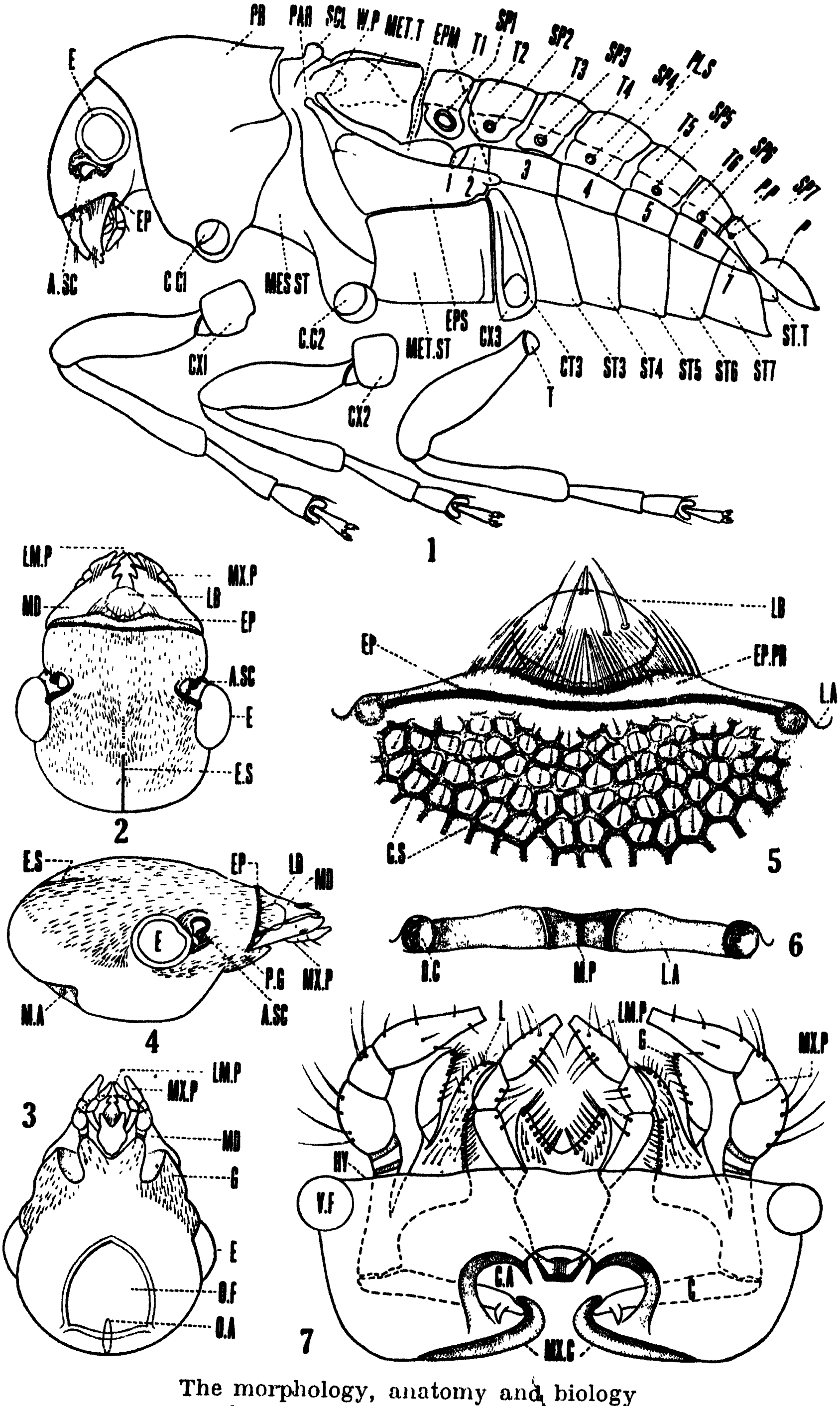
Fig. 5. — Dorsal aspect of the anterior part of the head: C.S = clathrate sculpture; EP = epistoma; EP.PR = epistomal process; L.A = lateral articulation of the mandible; LB = labrum. — × 39.5.

Fig. 6. — Ventral aspect of the epistomal area: D.C = dorsal condyle for the articulation of the mandible; L.A = lateral arm; M.P = median part. — × 39.5.

Fig. 7. — Ventral anterior part of the head, drawn inside (diagramatic to show connection of mouth parts): C = cardo; C.A = semi-circular apodeme; G = galea; HY = hypostoma; L = lacinia; LM.P = labial palp; MX.C = maxillary condyle; MX.P = maxillary palp; V.F = ventral fossa. — × 48.

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Plate I



The morphology, anatomy and biology
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Explanation of Plate II

Fig. 8. — Mandible, dorsal: a, b, c, d = four groups of bristles; AB.M = abductor muscle; AD.M = adductor muscle; AP.T = apical tooth; D.F = dorsal fossa; L.C = lateral condyle; MD PR = mandibular process; M.G = mandibular gland; MOL = molar; M.T = median tooth; S.AP.T = subapical tooth. — × 31.

Fig. 9. — Mandible, ventral: AP.T = apical tooth; L C - lateral condyle; M.G = mandibular gland; MOL = molar; M.T = median tooth: S.AP.T - subapical tooth; V.C = ventral condyle. — × 31.

Fig. 10. — Portion of the mandibular gland (much enlarged).

Fig. 11. — Labrum, dorsal: C = clypeus; EP - epistoma; LB = labrum. — × 44.

Fig. 12. — Labrum, ventral: EPH = epipharynx. — × 44.

Fig. 13. — Labium, dorsal: LI = ligula; LM.P labial palp; MS = muscles; P.M = prementum; S.M - submentum; V.W = ventral wall of the head. — × 57.5.

Fig. 14. — Abnormal labium: LPLI = labial palpi and ligula combined. — × 51.

Fig. 15. — Maxilla: C - cardo; C.PR = cardo process; GAL = galea; LAC = lacinia; MX.P = maxillary palp; S.G - subgalea; ST - stipes. — × 57.5.

Fig. 16. — Antenna: CL = club; PED = pedicel; SC = scape. — × 20.

Fig. 17. — Antenna: PED = pedicel; SC = scape. — × 51.

Fig. 18. — Antenna, club. — × 49.

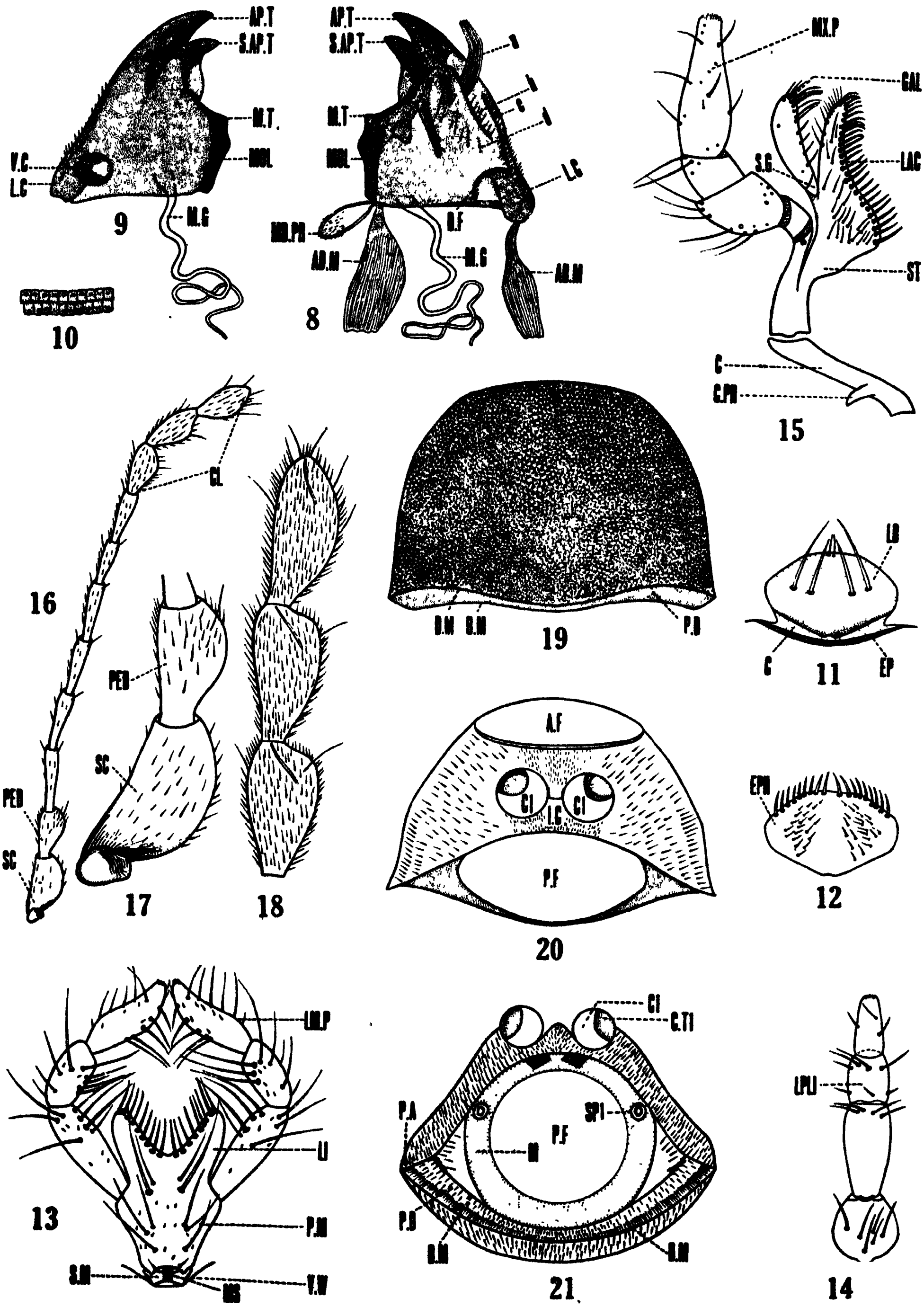
Fig. 19. — Pronotum: B.M - basal margin; D.M = dorsal margin; P.D = posterior declivity. — × 10.5.

Fig. 20. — Prothorax, sternal aspect: A.F = anterior foramen; C1 = fore coxa; I.C = intercoxal area; P.F = posterior foramen. — × 10.5.

Fig. 21. — Prothorax, viewed posteriorly: C1 = fore coxa; C T1 = cavity for the articulation of the trochanter; B.M = basal margin; D.M = dorsal margin; M = membrane; P.A = posterior angle; P.D = posterior declivity; P.F = posterior foramen; SP1 = first thoracic spiracle. — × 10.5.

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Plate II



The morphology, anatomy and biology
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Explanation of Plate III

Fig. 22. — Mesotergum, dorsal; L.A = lateral arm of prescutum; L.PR = lateral or mesonotal process; P = prephragma; PS = prescutum; SC = scutum; SCL = scutellum. — × 22.5.

Fig. 23. — Mesotergum, ventral view: A.AP = anterior apodeme; L.AP = longitudinal apodeme. — × 22.5.

Fig. 24. — Meso- and metathoracic sternites: C3 = hind coxa; CC2 = coxal cavity of the mid leg; C.T3 = cavity for the articulation of the trochanter of the hind leg; EPM = meso-epimeron; EPS.A = meso-episternal area; I.C = intercoxal area; M.EPS = meta-episternum; P = apical projection of meta-epimeron; P.EPS = pre-episternum; P.EPS.P = pre-episternal process; PRES = presternum; S2 and S3 = meso- and metasterna; ST.A = sternellar area; ST.P = sternellar piece. — × 10.5.

Fig. 25. — Metatergum, dorsal: A.D = anterior disc; A.N.P = anterior notal process; A.SC = anterior scutal lobe; L.SC = lateral margin of scutum: M = membrane; M.A = membranous area of prescutum; M.D = muscle disc; M.G = median groove; M PS.A = median prescutal area; P.N = postnotum; P.N.P = posterior notal process; P.SC = posterior scutal lobe; PS.L = prescutal lobe; SCL = scutellum. — × 13.

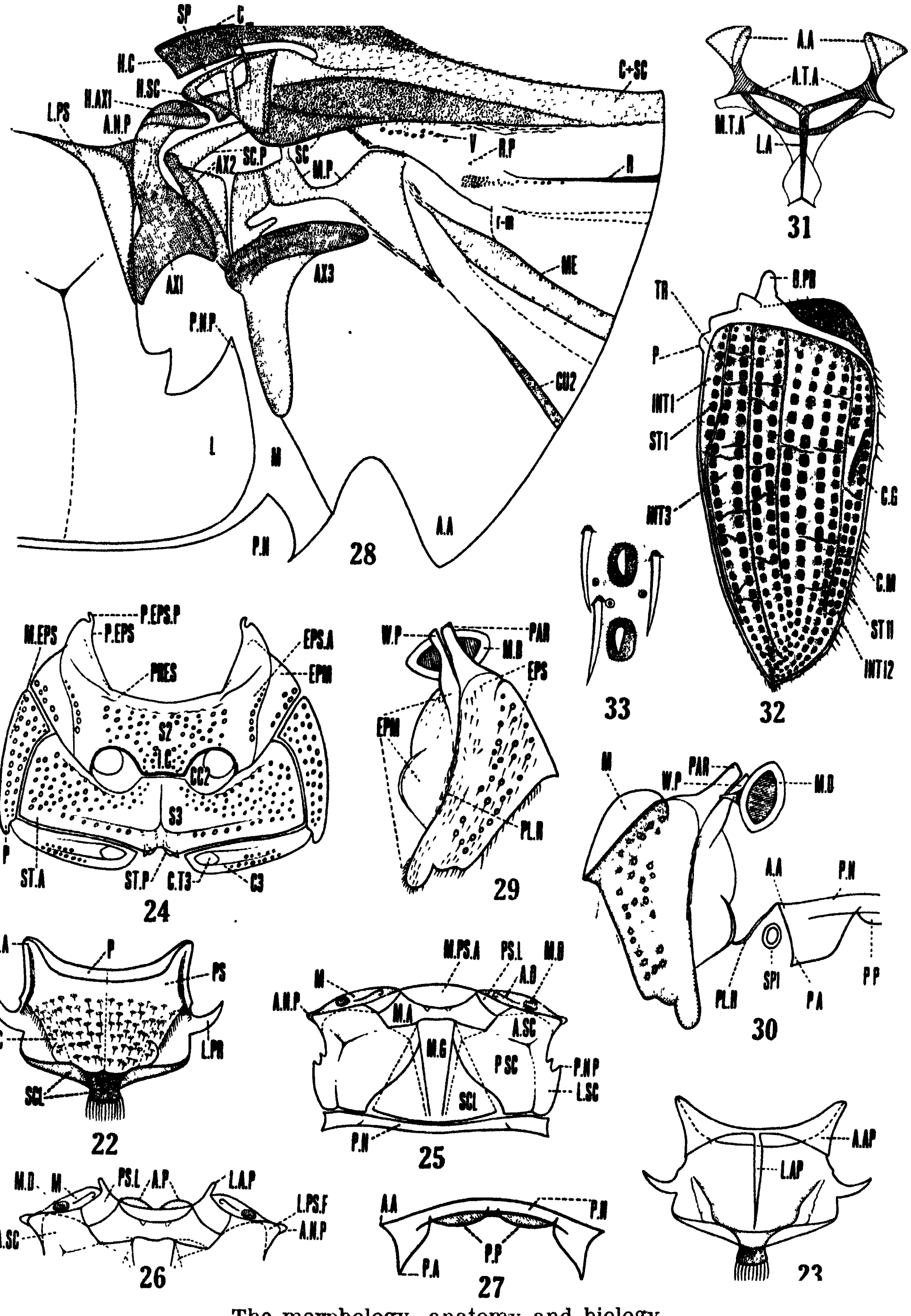
Fig. 26. — Anterior area of metatergum: A.N.P = anterior notal process; A.P = anterior phragma or prephragma; A.SC = anterior scutal lobe; L.A.P = lateral arm of prephragma; L.PS.F = lateral prescutal fold; M = membrane; M.D = muscle disc; PS.L = prescutal lobe. — × 13.

Fig. 27. — Postnotum and postphragma: A.A = anterior arm of postnotum; P.A = posterior arm of postnotum; P.N = postnotum; P.P = postphragma. — × 13.

Fig. 28. — Base of wing and its articulation to metatergum: A.A = anal area; A.N.P = anterior notal process; AX1, AX2. AX3 = first, second and third sclerite; C = costa; C + SC = costa and subcosta combined; CU2 = cubitus; H.AX1 = head of first axillary sclerite; H.C = head of costa; H.SC = head of subcosta; L = lateral margin of scutum; L.PS = lateral part of prescutum; M = membrane; ME = media; M.P = median plate; P.N = postnotum; P.N.P = posterior notal process; R = radius; r-m = vestigeal connection between

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Plate III



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Explanation of Plate III (continuation)

radius and media ; R.P = radial plate ; SC = subcosta ; SC.P = subcostal plate ; SP = spur between costa and subcosta ; V = vesicles ? — (much enlarged).

Fig. 29. — Metapleurite, dorsal : EPM = epimeron ; EPS = episternum ; M.D = muscle disc ; PAR = parapterum ; PL.R = pleural ridge ; W.P = wing process. — (much enlarged).

Fig. 30. — Metapleurite, ventral : A.A = anterior arm of postnotum ; M = membrane ; M.D = muscle disc ; P.A = posterior arm of postnotum ; PAR = parapterum ; PL.H = pleural hook ; P.N = postnotum ; P.P = postphragma ; SP1 = first abdominal spiracle ; W.P = wing process. — × 17.

Fig. 31. — Endoskeleton : A.A = anterior arms ; A.T.A = anterior, transverse apodeme ; L.A = longitudinal apodeme ; M.T.A = median, transverse apodeme. = × 14.5.

Fig. 32. — Left-elytron, inside : B.PR = basal process ; C.G. = costal groove ; C.M = costal margin ; INT1, INT3 and INT12 = interspaces 1, 3 and 12 ; P = projection fitting into a groove of the elytron ; ST1 and ST11 = striae 1 and 11 ; TR = trachea. — × 10.

Fig. 33. — Vestiture of elytron. — × 62.5.

Explanation of Plate IV

Fig. 34. — Articulation of elytra: AX1, AX2 and AX3 = first, second and third axillary sclerites; A.P = anterior phragma or prephragma; B.PR = basal process; L = ligament; M.P = median plate; P.EPS = pre-episternum; P.EPS.P - pre-episternal process; R.P = radial pital; SCL = scutellum. — (much enlarged).

Fig. 35. — Hind wing: A.A - anal area; A.M = anal margin; AX1 and AX3 = first and third axillary sclerite; C = costa; C + SC = costa and subcosta combined; C.M = costal margin; CU1 and CU2 = cubitus; M = media; Mr = recurrent media; R = radius; Rr = recurrent radius; SC = subcosta. — × 7.5.

Fig. 36. — Wing folded, ventral aspect: C = costa; CU1 and CU2 = cubitus; L.a and L.b = longitudinal folds; R = radius; T.a and T.b = transverse folds. — (much enlarged).

Fig. 37. — Fore-leg: AP = apodeme; C1 = coxa; CL = claws; FE = femur; TB = tibia; T.G - transverse groove; TR = trochanter; ts1-ts5 = five joints of tarsi. — × 14.

Fig. 38. — Last four joints of tarsi: CL - claws; ts1-ts5 = five joints of tarsi. — × 22.5.

Fig. 39. — Mid coxa: AP = apodeme; C.A.T2 - cavity for the articulation of the trochanter. — × 14.

Fig. 40. — Hind coxa, dorsal. — × 11.

Fig. 41. — Hind coxa, ventral: C.A.T3 = cavity for the articulation of the trochanter; C3 = coxa; M.D = muscle disc; M.EPM = posterior end of meta-epimeron. — × 11.

Fig. 42. — Femur, inside: H = hollow. — × 12.5.

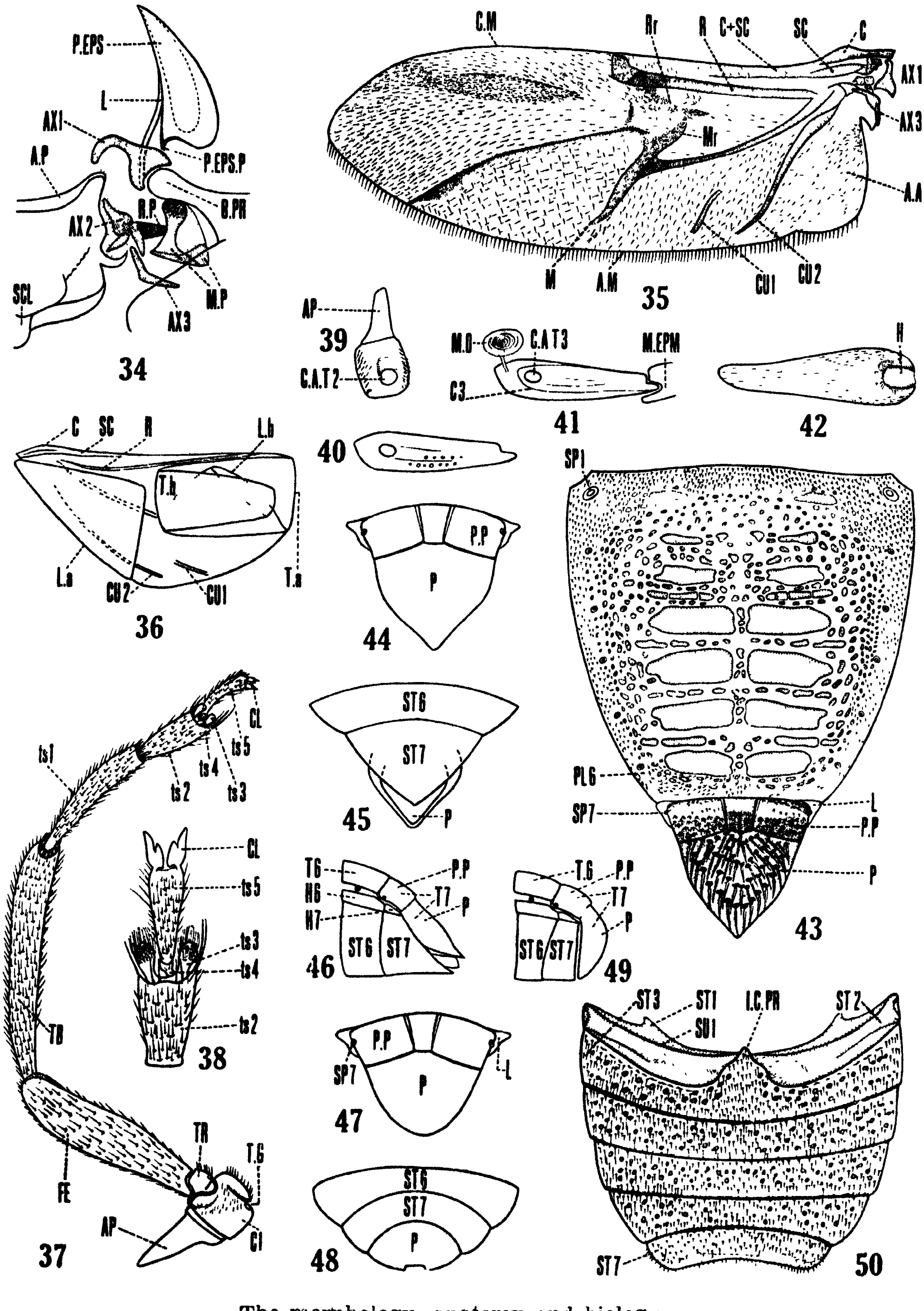
Fig. 43. — Abdominal tergites of the female: L = ligament; P = pygidium; PL6 = sixth pleurite; P.P = pro-pygidium; SP1 and SP7 = first and seventh abdominal spiracles. — (much enlarged).

Fig. 44. — The last two external abdominal tergites of the female: P = pygidium or eighth tergite; P.P = pro-pygidium or seventh tergite. — × 12.5.

Fig. 45. — The last two external sternites of the female: P = pygidium or eight tergite; ST6 and ST7 = sixth and seventh sternites. — × 12.

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Plate IV



The morphology, anatomy and biology
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Explanation of Plate IV (continuation)

Fig. 46. — End of the female abdomen, lateral: H6 and H7 = sixth and seventh hypopleurites; P = pygidium or eight tergite; P.P = pro-pygidium or seventh tergite; ST6 and ST7 = sixth and seventh sternites; T6 and T7 = sixth and seventh tergites. — × 10.

Fig. 47. — The last two external abdominal tergites of the male: L = ligament; P = pygidium or eight tergite; P.P = pro-pygidium or seventh tergite; SP7 = seventh abdominal spiracle. — × 12.5.

Fig. 48. — The last two external sternites of the male: P = pygidium or eight tergite; ST6 and ST7 = sixth and seventh sternites. — × 12.

Fig. 49. — End of the male abdomen, male: P = pygidium or eight tergite; P.P = pro-pygidium or seventh tergite; ST6 and ST7 = sixth and seventh sternites; T6 and T7 = sixth and seventh tergites. — × 10.

Fig. 50. — Abdominal sternites of the male: I.C.PR = intercoxal process; ST1, ST2, ST3 and ST7 = first, second, third and seventh sternites; SU1 = first suture between first and second sternite. — (much enlarged).

Explanation of Plate V

Fig 51. — Internal segments of the male, ventral: SP = spicule; ST8 = eighth sternite; T9 = ninth tergite. — × 17.

Fig. 52. — Internal segments of the male, lateral, with rectum; A = anus; L.C = lateral chitinisation in ninth tergite; R = rectum; R.C = chitinisation on the rectum; SP = spicule; T9 = ninth tergite. — × 17.

Fig. 53. — Internal segments of the female, dorsal, with rectum: A.T = anal tube; OV = ovipositor; R = rectum; ST.T = ninth sternal and tergal tube. — × 26.

Fig. 54. — Internal segments of the female, lateral, with rectum: A = anus; A.T = anal tube; R = rectum; ST.T = ninth sternal and tergal tube. — × 26.

Fig. 55. — Female genitalia, dorsal: COX = coxite; M = membrane; SP = spines; ST = stylus. — × 22.5.

Fig. 56. — Female genitalia, lateral: COX = coxite; M = membrane; SP = spines; ST = stylus; V.T = vaginal tube. — × 22.5.

Fig. 57. — Male genitalia, lateral: C.S = chitinised spur; D.L = dorsal lobe of median plate; E.D = ejaculatory duct; FL = flagellum; M.P = median plate; M.S = median struts; P = papillae; SP = spicule; T = tegmen; T.D = transverse denticle; V.L = ventral lobe of median plate. — × 22.5.

Fig. 58. — Male genitalia, ventral (spicule omitted): D.L = dorsal lobe of median plate, G = groove on distal end of the tegmen; M.S = median plate; T = tegmen; V.L = ventral lobe of median plate. — × 22.5.

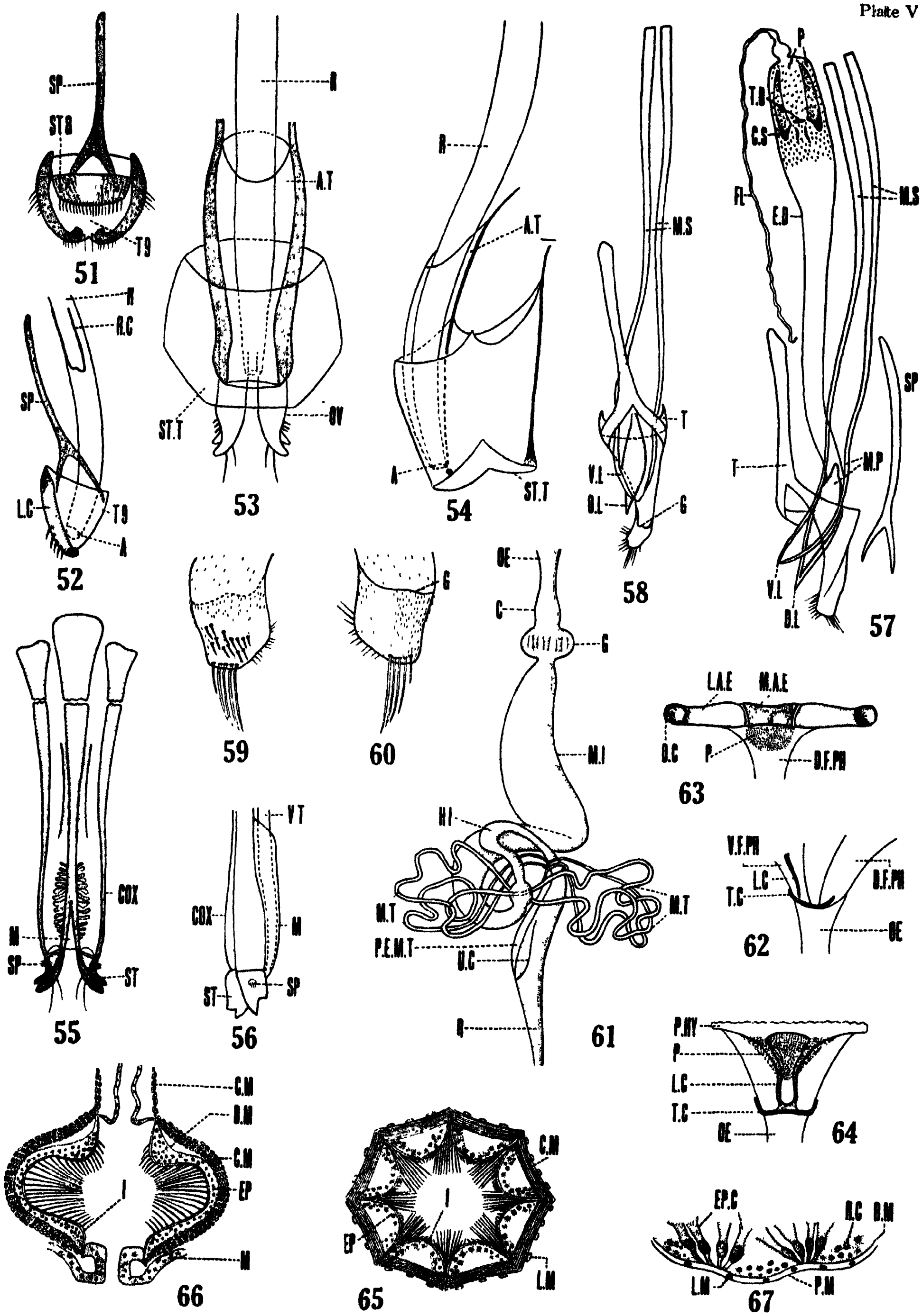
Fig. 59. — Distal end of tegmen, dorsal. — × 66.

Fig. 60. — Distal end of tegmen, ventral. — × 66.

Fig. 61. — Alimentary canal of the adult: C = crop; G = gizzard; H.I = hind intestine; M.I = mid intestine; M.T = malpighian tubes; OE = oesophagus; P.E.M.T = posterior end of malpighian tubes; R = rectum; U.C = U-shaped chitinisation. — (much enlarged).

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Plate V



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Expanation of Plate V (continuation)

Fig. 62. — Pharyngeal folds, lateral : D.F.PH = dorsal fold of pharynx ; L.C = longitudinal chitinisation in ventral fold ; OE = oesophagus ; T.C = transverse chitinisation between pharynx and oesophagus : V.F.PH = ventral fold of pharynx. — (much enlarged).

Fig. 63. — Pharyngeal region, dorsal : D.C = dorsal condyle at lateral end of epistoma ; D.F.PH = dorsa fold of pharynx ; L.A.E = lateral arm of epistoma ; P = papillae. — × 20.

Fig. 64. — Pharyngeal region, ventral : L.C = longitudinal chitinisation in ventral fold ; OE = œsophagus ; P = papillae ; P.HY = posterior end of hypostoma ; T.C = transverse chitinisation between pharynx and œsophagus. — (much enlarged).

Fig. 65. — Transverse section in gizzard : B.M = basement membrane ; C.M = circular muscles ; EP = epithelium ; I = intima or chitinised layer lining the gizzard ; M = mesentron of mid intestine. — (much enlarged).

Fig. 66. — Longitudinal section in gizzard : C.M = circular muscles ; EP = epithelium ; I = intima or chitinised layer lining the gizzard ; L.M = longitudinal muscles. — (much enlarged).

Fig. 67. — Transverse section in mid-intestine : B.M = basement membrane ; EP.C = epithelial cells ; L.M = longitudnial muscles ; P.M = peritonial membrane ; R.C = regenerative cells of epithelium. — (much enlarged).

Explanation of Plate VI

Fig. 68. — Transverse section in hind intestine, ilium region: C.M = circular muscles; EP = epithelium; I = intima; L.M = longitudinal muscles; M.T = malpighian tubes; P = peritone. — (much enlarged).

Fig. 69. — Transverse section in hind intestine, colon region; C = chitinised streak on both sides; C.M = circular muscles; EP = epithelium; I = intima; M.T = malpighian tubes; P = peritone. — (much enlarged).

Fig. 70. — Transverse section in the rectum: C.M = circular muscles; EP = epithelium; I = intima. — (much enlarged).

Fig. 71. — Nervous system of the adult: A.N = antennal nerves; E = eye; LB.N = labral nerve; O.L = optic lobes; PR.L = protocerebral lobe. — (much enlarged).

Fig. 72. — Lateral view of the nervous system in the head and prothorax: G = gizzard; LM.N = labial nerve; MD.N = mandibular nerve; MX.N = maxillary nerve; OE = œsophagus; O.L = optic lobe; PR.L protocerebral lobe; SO.G = sub-œsophageal ganglion; TH1.G = first thoracic ganglion. — (much enlarged).

Fig. 73. — Mature reproductive organs of the female: B C = bursa copulatrix; C = internal and lateral chitinisation in bursa copulatrix; FIL = filaments; GER = germarium; M = muscles; P.OV = paired oviduct; SP = spermatheca; SP.D = spermathecal ducts; UT = uterus; VAG = vagina; VIT = vitellarium. — (much enlarged).

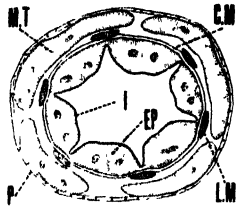
Fig. 74. — Immature reproductive organs of the female: B.C = bursa copulatrix; FIL = filaments; GER = germarium; SP = spermatheca; SP.G = spermathecal gland; UT = uterus; VAG = vagina. — (much enlarged).

Fig. 75. — Striated and rough surface of uterus. — (much enlarged).

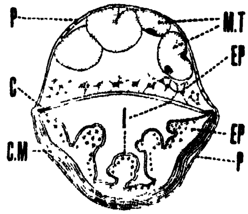
Fig. 76. — Male reproductive organs and genitalia (spicule not drawn): A.G = accessory gland; E.D = ejaculatory duct; L = lobes of the median plate; M = muscles; S.T = seminal tube; T = tegmen; TS = testes; V.D = vas deferens; V.S = vesicula seminalis. — (much enlarged).

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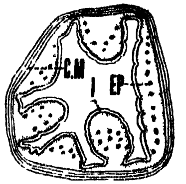
Plate VI



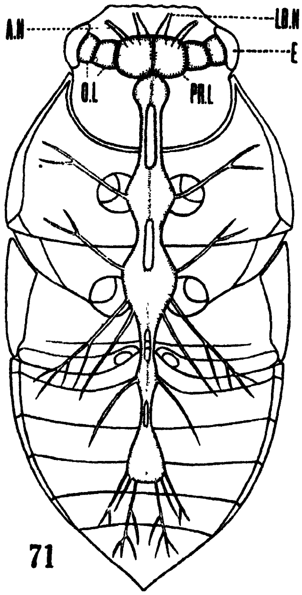
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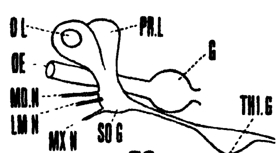
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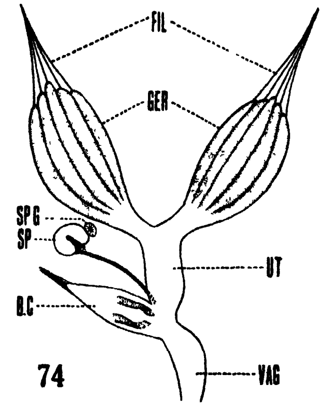
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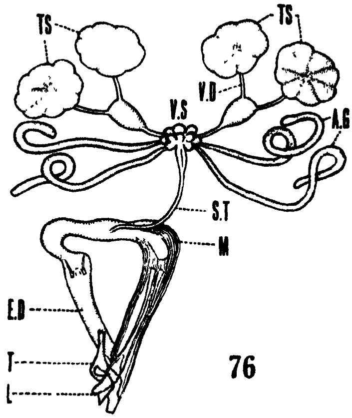
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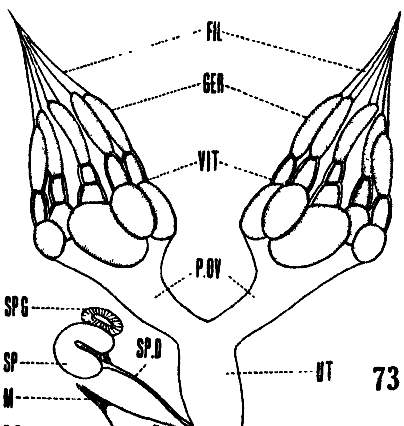
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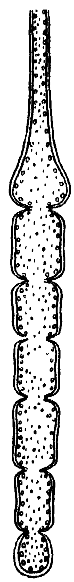
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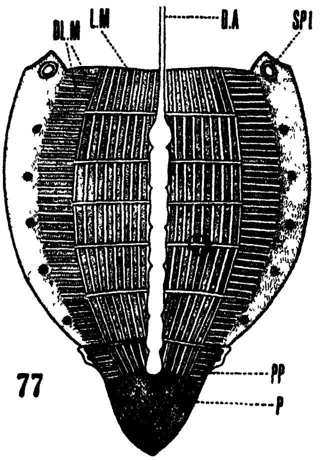
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Explanation of Plate VI (continuation)

Fig. 77. — Abdominal tergites, internal, showing heart and tergal muscles: D.A = dorsal aorta; DL.M = dorso-lateral muscles; L.M = longitudinal muscles; P = pygidium; P.P = propygidium; SP1 = first abdominal spiracle. — (much enlarged).

Fig. 78. — Heart of the adult. — (much enlarged).

Explanation of Plate VII

Fig. 79. — Transverse section in adult heart: A.M = alary muscles; B.C = blood corpuscles; F.B = fat bodies; N = nucleus; P.N = pericardial nephrocyte; P.W = pericardial wall; W.H = wall of heart. — (much enlarged).

Fig. 80. — Respiratory system: D.T = dorsal trachea; E.T = trachea that gives rise to tracheation of elytra; H = head; H.W.T. = trachea that gives rise to tracheation of the hind wing; M.TH = meta-thorax; MT.TH = metathorax; P.TH = prothorax; V.T = ventral trachea. — (much enlarged).

Fig. 81. — The egg. — × 15.

Fig. 82. — The mature larva. — × 4.

Fig. 83. — Head of larva, dorsal. — × 20.

Fig. 84. — Head of larva, front view: ANT = antenna, C = clypeus; D.A = dorsal articulation of the mandible; EP = epistoma; H.B = hypo-pharyngeal bracon; LM = labium; MX = maxilla; OC = ocellus. — (much enlarged).

Fig. 85. — Head of larva, ventral: O.A = occipital apodeme; T.B = tentorial bridge. — × 22.

Fig. 86. — Dorsal part of the head of the larva, from the inside: ANT = antenna: C = clypeus; D.A = dorsal articulation; EP = epistoma; LB = labrum. — × 50.

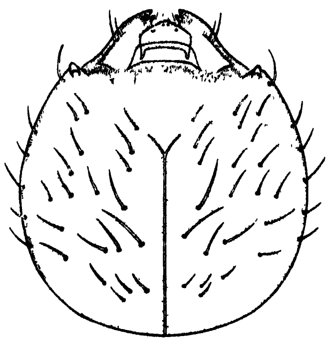
Fig. 87. — Mandible of the larva: AB.N = abductor muscle; AD.M = adductor muscle; AP.T = apical tooth; D.F = dorsal fossa; MED = median tooth; MOL = molar; S.AP.T = subapical tooth; V.C = ventral condyle. — × 54.

Fig. 88. — Maxilla of the larva: A.L = anterior lobe; C = cardo; L.T = lacinal tooth; MX.P = maxillary palp; ST = stipes. — × 51.

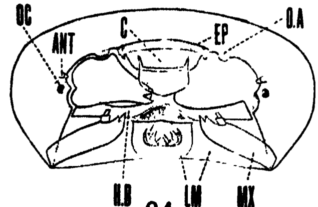
Fig. 89. — Anterior part of the head, ventral, after removing labium and maxillae: ANT = antenna; F.G = fore-gut; H.B = hypopharyngeal bracon; H.PR = hypopharyngeal process; H.S = hypopharyngeal sclerome; MD = mandible. — (much enlarged).

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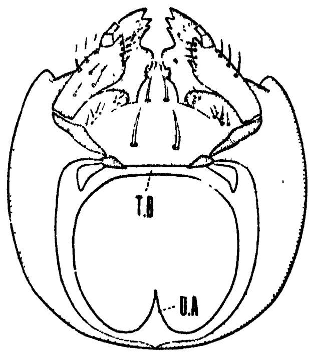
Plate VII



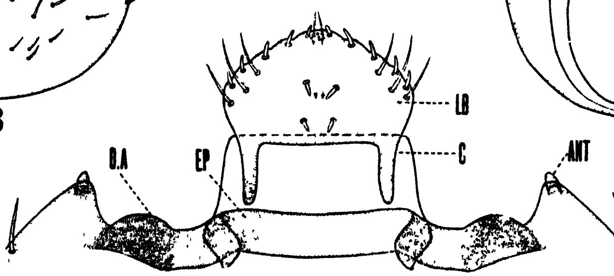
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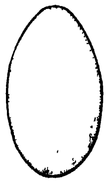
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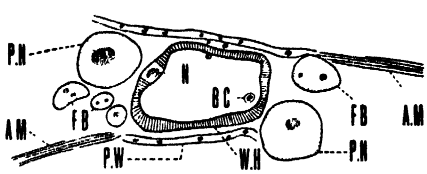
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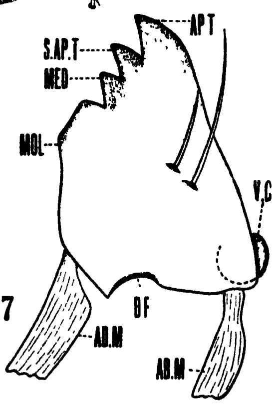
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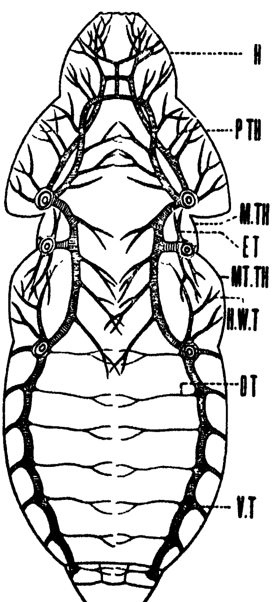
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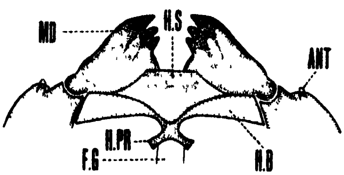
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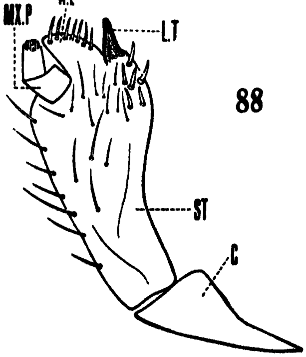
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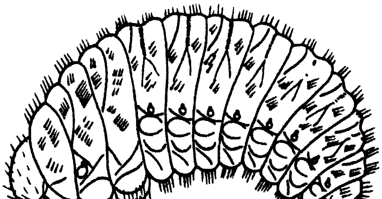
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The morphology, anatomy and biology
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Explanation of Plate VIII

Fig. 90. — Mentum and prementum, frontal view: H.S = hypopharyngeal sclerome; M = mentum; P.M = prementum. — (much enlarged).

Fig. 91. — Labium of the larva, ventral: LM.MX.A = labial and maxillary articulation; M = mentum; P.M = prementum; S.M = submentum. — × 48.

Fig. 92. — Tergal and pleural lobes of the pro- and mesothorax: A.D = anterior division of mesotergum; AL.A = alar area; EP.L = epipleural lobe; P.D = posterior division of mesotergum; P.L = pedal lobes; PL.L = pleural lobe of prothorax; PR = pronotum; TH.SP = thoracic spiracle. — (much enlarged)

Fig. 93. — Tergal, pleural and sternal lobes of the abdomen: AB.SP = abdominal spiracle; A.D = anterior division of mesotergum; AL.A = alar area; C.L = coxal lobe; EP.L = epipleural lobe; EU = eusternum; HY.L = hypopleural lobe; P.D = posterior division of mesotergum; TU = tubercles. — (much enlarged).

Fig. 94. — Alimentary canal of the larva: C = crop; G = gizzard; M.I = mid-intestine; M.T = malpighian tubes; OE = œsophagus; R = rectum; S.G = salivary gland. — (much enlarged).

Fig. 95. — Nervous and respiratory systems of the larva (much enlarged).

Fig. 96. — Thoracic spiracle of the larva, biforous and large. — × 107.

Fig. 97. — Abdominal spiracle of the larva, uniforous and small. — × 107.

Fig. 98. — Pupa, dorsal: PR = lateral process of ninth segment; T7, T8, T9 and T10 = seventh, eighth, ninth and tenth tergites. — (much enlarged).

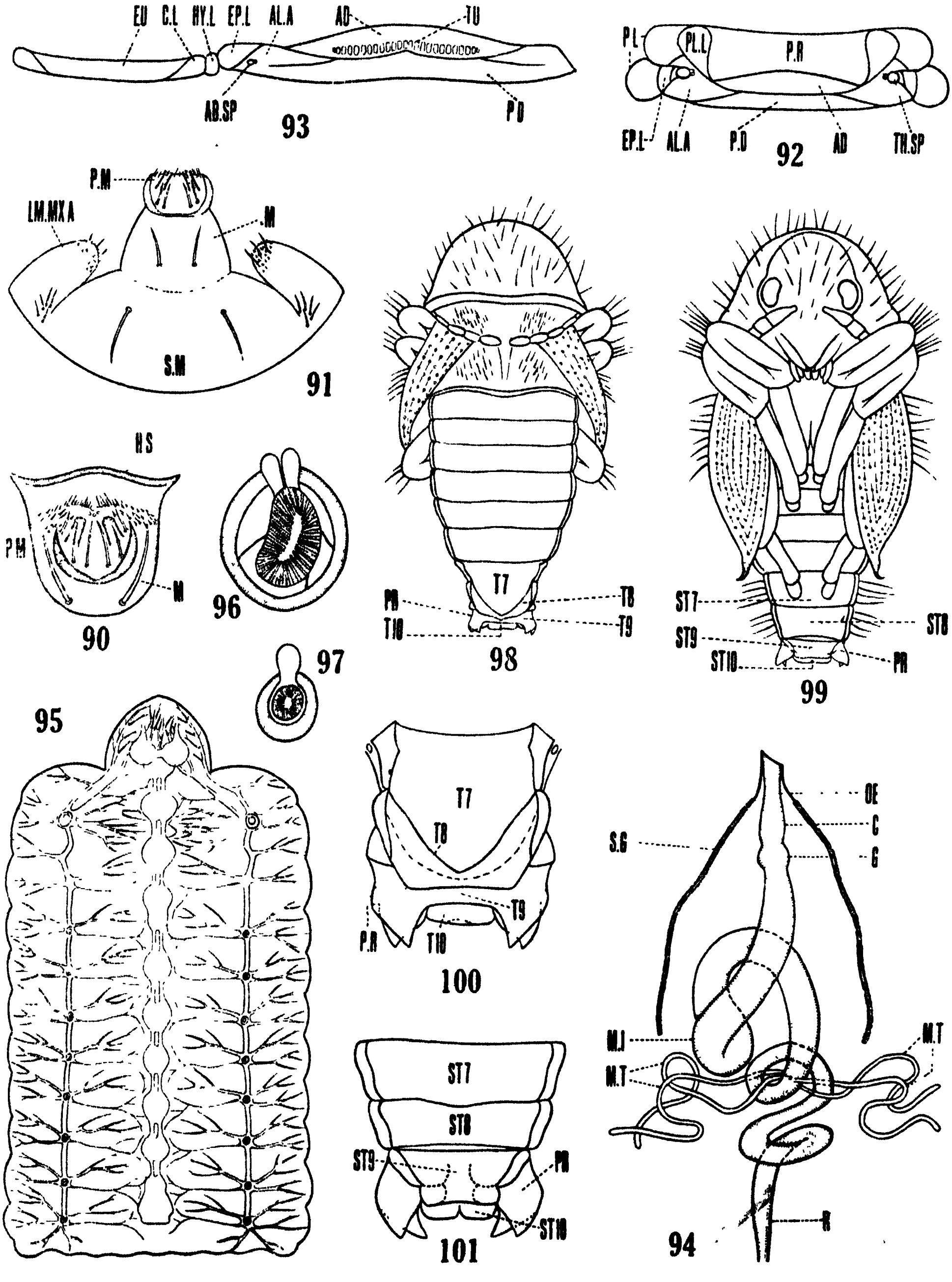
Fig. 99. — Pupa, ventral. PR = lateral process of ninth segment; ST7, ST8, ST9 and ST10 = seventh, eighth, ninth and tenth sternites. — (much enlarged).

Fig. 100. — Last four abdominal segments of the pupa, dorsal: PR = lateral processes of ninth segment; T7, T8, T9 and T10 = seventh, eighth, ninth and tenth tergites. — × 17.

Fig. 101. — Last four abdominal segments of the pupa, ventral: PR = lateral process of ninth segment; ST7, ST8, ST9 and ST10 = seventh, eighth, ninth, and tenth sternites — × 13.

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Plate VIII



The morphology, anatomy and biology of *Araecerus fasciculatus* De Geer

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161.—Last fou.

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eighth, ninth,

Les *Tachysphex* de la faune égyptienne

[Hymenoptera : Sphecidae]

(avec 1 Figure)

par JACQUES DE BEAUMONT

L'étude des *Tachysphex* de la faune égyptienne a pu être entreprise grâce à l'obligeance de mes collègues d'Egypte. Monsieur le Professeur Docteur H. Priesner, Directeur de la Section d'Entomologie du Ministère de l'Agriculture, a bien voulu m'adresser la collection de ce Département, au complet; Monsieur A. Alfieri, Secrétaire Général et Conservateur de la Société Fouad I[er] d'Entomologie, m'a fait parvenir les exemplaires appartenant au Musée de la Société et ceux de sa propre collection ; Monsieur le Professeur Docteur A. Mochi a mis à ma disposition les individus provenant de ses récoltes. C'est un vif plaisir pour moi de remercier ici ces distingués collègues.

Dans la présente étude, les caractères utilisés pour la détermination sont ceux adoptés dans mon travail relatif aux *Tachysphex* de France (¹). Quelques indications complémentaires, concernant certains caractères, sont données ci-dessous :

Peigne rudimentaire au tarse du ♂ : Entre les ♂♂ ayant un peigne rudimentaire et ceux qui n'en ont pas, il y a quelques intermédiaires. On peut parler d'un peigne lorsqu'il existe à l'extrémité des deux premiers articles deux épines voisines, celles du deuxième article dépassant en général l'apex du troisième, et, naturellement, quelques épines le long du métatarse (premier article).

Pièces buccales : Il y a deux types principaux : dans les groupes de *panzeri* v. d. Lind. et de *luxuriosus* Morice, le labre est très développé et la galea des maxilles est longue ; dans les autres groupes, le labre est moins développé et la galea courte.

La Table de détermination qui suit ne comprend que les espèces sûres. Outre ces espèces, il reste quelques individus que je ne sais comment classer. Des renseignements complémentaires permettront de leur assigner une place, soit comme espèces distinctes, soit comme simples variétés.

(¹) Jacques de Beaumont : Les *Tachysphex* de la faune française (*Annales de la Société Entomologique de France*, Vol. CV, 3ᵉ trim., 1936, pp. 178-184).

TABLE DE DETERMINATION

Distinction des sexes

♀ : 12 articles aux antennes; 6 segments visibles à l'abdomen, le 6e présentant une aire pygidiale nettement limitée; fémurs antérieurs non échancrés à la base; tarses antérieurs portant un peigne formé d'épines fines et longues.

♂ : 13 articles aux antennes; 7 segments visibles à l'abdomen, le 7e ne présentant pas d'aire pygidiale nettement limitée; fémurs antérieurs échancrés à la base; tarses antérieurs portant tout au plus un peigne rudimentaire.

♀♀

1. Mandibules sans échancrure sur leur arête inférieure; pas de peigne au tarse antérieur; abdomen noir, brillant, avec une ponctuation nette et espacée .... *T. holognathus* Morice

— Une échancrure aux mandibules; un peigne au tarse antérieur; pas de ponctuation nette à l'abdomen 2

2. Labre bombé, dépassant nettement le bord antérieur du clypéus; galea des maxilles à peu près aussi longue que le scape sans son bouton articulaire (ce dernier caractère n'est visible que lorsque les pièces buccales sont dépliées) 3

— Labre aplati, entièrement ou presqu'entièrement caché sous le clypéus; galea des maxilles beaucoup plus courte 13

3. La distance interoculaire égale au moins la longueur des articles 2+3 du funicule; face dorsale du segment médiaire plus ou moins nettement striée 4

— La distance interoculaire égale au plus la longueur des 2 premiers articles du funicule; face dorsale du segment médiaire non striée 5

4. Abdomen entièrement rouge .... *T. luxuriosus* Morice

— Abdomen noir dans sa partie postérieure .... *T. horus* nov. spec.

5. Abdomen entièrement noir; ailes fortement enfumées .... *T. chephren* nov. spec.

— Abdomen rouge, au moins à la base 6

6. Mandibules avec une échancrure très développée; leur partie basale, avant l'échancrure, plus haute que longue et se terminant par un angle

proéminent ; des bandes de pruinosité sur les 5 premiers tergites .... *T. buyssoni* Morice

— Mandibules avec une échancrure moins développée ; leur partie basale plus longue que haute 7

7. Le plus long éperon des tibias postérieurs avec des dents assez fortes ; tout le thorax et le segment médiaire recouverts d'une forte pilosité laineuse ; des bandes de pruinosité sur les 5 premiers tergites .... *T. micans* Rad.

— Le plus long éperon des tibias postérieurs avec des dents beaucoup plus fines ; pilosité de la tête et du thorax beaucoup moins développée ; pas de pruinosité sur le 5ᵉ tergite 8

8. Bord antérieur du clypéus sans échancrure au milieu 9

— Bord antérieur du clypéus avec une petite échancrure au milieu 10

9. Articles des palpes longs ; aire pygidiale à peu près plane, étroite et pas très brillante ; pas de pruinosité argentée à l'abdomen .... *T. longipalpis* nov. spec.

— Articles des palpes courts ; aire pygidiale bombée, assez large et très brillante .... *T. mycerinus* nov. spec.

10. Ailes antérieures nettement enfumées ; pas de bandes de pruinosité à l'abdomen .... *T. gracilicornis* Mercet

— Ailes antérieures pas ou peu enfumées ; des bandes de pruinosité à l'abdomen 11

11. Aire pygidiale brillante, assez large ; bord antérieur du clypéus avec un petit redent de chaque côté, près de ses angles latéraux (individus frais !) ; le 4ᵉ tergite presque toujours dépourvu de pruinosité argentée .... *T. pygidialis* Kohl

— Aire pygidiale moins brillante, finement chagrinée, plus étroite ; bord antérieur du clypéus sans redents près de ses angles latéraux ; le 4ᵉ tergite presque toujours avec une bande de pruinosité 12

12. Face dorsale du segment médiaire recouverte d'une pilosité dense, cachant la sculpture chez les individus frais ; la distance interoculaire est plus courte que la longueur du 2ᵉ article du funicule .. *T. cheops* nov. spec.

— Pilosité du segment médiaire moins dense, ne cachant pas la sculpture ; distance interoculaire presque toujours au moins égale à la longueur du 2ᵉ article du funicule .... *T. panzeri* v. d. Lind.

13. Abdomen entièrement noir 14
— Abdomen en partie rouge ou entièrement rouge 29
14. Le plus grand éperon des tibias postérieurs avec des dents espacées et très fortes; mésonotum avec une sculpture aréolée; une bande enfumée au travers des ailes antérieures .... *T. schmiedeknechti* Kohl
— Le plus grand éperon des tibias 3 avec des dents fines et serrées; mésonotum plus ou moins distinctement ponctué; pas de bande enfumée au travers des ailes antérieures 15
15. Segment médiaire et base du premier tergite avec une forte pilosité d'aspect laineux; aire pygidiale finement réticulée, entièrement mate .... *T. albocinctus* Lucas
— La pilosité du segment médiaire n'est jamais laineuse; aire pygidiale presque toujours plus ou moins brillante 16
16. Aire pygidiale large et arrondie à l'extrémité 17
— Aire pygidiale plus étroite et triangulaire 18
17. Côtés du segment médiaire en général finement striés; clypéus moins aplati .... *T. julliani* Kohl
— Côtés du segment médiaire non striés; clypéus plus aplati .... *T. abjectus* Kohl
18. Tibias en partie rouges 19
— Tibias entièrement noirs 21
19. Premier sternite non caréné longitudinalement; bord postérieur des tergites décoloré; vertex large; bord antérieur du clypéus anguleux .... *T. fasciatus* Morice
— Premier sternite caréné; bord postérieur des tergites non décoloré; vertex étroit; bord antérieur du clypéus non anguleux 20
20. Fémurs 1 et 2 avec une pilosité dressée; aire pygidiale nettement bordée .... *T. maidli* nov. spec.
— Fémurs 1 et 2 sans pilosité dressée; aire pygidiale plus étroite et moins nettement bordée .... *T. mantivora* nov. spec.
21. Pas de suture épisternale aux mésopleures; cellule radiale très fortement tronquée. Aire pygidiale très mate .... *T. imperfectus* nov. spec.
— Une suture épisternale aux mésopleures; cellule radiale moins fortement tronquée; aire pygidiale plus ou moins brillante 22

22. Côtés du segment médiaire très brillants, avec une ponctuation très fine et espacée ; face dorsale du segment médiaire très fortement striée ; face à sculpture très fine d'aspect soyeux .... *T. plicosus* Costa

— Côtés du segment médiaire plus ou moins nettement striés, sa face supérieure moins nettement striée ; face ponctuée ou chagrinée 23

23. Base du premier tergite avec une pilosité dressée ; vertex, vu de face, concave ; mésopleures mates, sans ponctuation nette .... *T. priesneri* nov. spec.

— Base du premier tergite sans pilosité ; vertex non concave ; mésopleures brillantes ou nettement ponctuées 24

24. Mésopleures très brillantes, lisses ou à peine ponctuées ; taille faible ; face inférieure du scape et extrémité de l'aire pygidiale tachées de ferrugineux .... *T. cabrerai* Mercet

— Mésopleures nettement ponctuées, au moins en avant ; taille plus grande ; scape et aire pygidiale en général noirs 25

25. Antennes très longues ; les articles médians du funicule 4 ou 5 fois plus longs que larges .... *T. filicornis* Kohl

— Antennes moins longues ; les articles médians du funicule au plus 3 fois plus longs que larges 26

26. Ponctuation des mésopleures peu nette dans leur partie postérieure ; la distance interoculaire égale la longueur des articles 2+3 du funicule ; clypéus très aplati, sans aire apicale brillante nette .... T *helveticus* Kohl

— Ponctuation des mésopleures nette sur toute leur surface ; distance interoculaire plus courte que la longueur des articles 2+3 du funicule ; clypéus moins plat avec une aire apicale brillante nette 27

27. Aire apicale brillante du clypéus plus longue ou aussi longue au milieu que l'aire basale ponctuée .... *T. nitidus* Spin.

— Aire apicale du clypéus plus courte que l'aire basale ponctuée 28

28. Deuxième sternite à ponctuation très étendue, ponctuation plus forte et plus espacée sur la face et sur le thorax ...... *T. nitidior* nov. spec.

— Partie postérieure du 2e sternite largement imponctuée ; ponctuation de la face et du thorax plus serrée .... *T. tarsinus* Lep.

29. Aire pygidiale large à l'extrémité, ou divisée transversalement en 2 zones différement sculptées 30

— Aire pygidiale pointue à l'extrémité et sans division transversale 31

30. Face et thorax recouverts d'une pilosité dense, cachant la sculpture chez les individus frais ; abdomen avec des bandes de pruinosité denses sur les 4 premiers tergites .... *T. vestitus* Kohl

— Pilosité de la face et du thorax beaucoup moins dense ; des bandes de pruinosité, moins développées, sur les 3 premiers tergites seulement .... *T. julliani* Kohl

31. Tibias noirs .... *T. pectinipes* L.

— Tibias plus ou moins tachés de rouge 32

32. Tête entièrement recouverte d'une pilosité appliquée, à vifs reliefs argentés, cachant complètement les téguments ; une pilosité semblable sur le thorax 33

— Pilosité de la tête et du thorax moins développée et moins argentée .. 34

33. Une carène longitudinale au premier sternite ; face moins bombée .... *T. osiris* nov. spec.

— Pas de carène longitudinale au premier sternite ; face avec un tubercule très saillant .... *T. isis* nov. spec.

34. Taille grande : aire pygidiale très fortement rétrécie en arrière ; premier sternite caréné longitudinalement .... *T. grandissimus* Gussak.

— Taille plus faible, aire pygidiale triangulaire ; pas de carène au premier sternite 35

35. Face avec une très forte protubérance ; funicule en partie rouge .... *T. deserticola* nov. spec.

— Face aplatie ; funicule noir .... *T. speciosissimus* Morice

♂♂

1. Mandibules sans échancrure sur leur arête inférieure ; abdomen noir, brillant, avec une ponctuation nette et espacée .... *T. holognathus* Morice

— Pas d'échancrure aux mandibules ; pas de ponctuation nette à l'abdomen 2

2. Labre bombé, dépassant nettement le bord antérieur du clypéus ; galea des maxilles à peu près aussi longue que le scape sans son bouton articulaire 3

— Labre aplati, entièrement ou presqu'entièrement caché par le clypéus ;

galea des maxilles beaucoup plus courte 15

3. Fémurs antérieurs sans échancrure à la base 4

— Fémurs avec l'échancrure habituelle à la base 5

4. Tarse antérieur portant un peigne rudimentaire; les épines situées à l'extrémité du 2e article dépassent l'apex du 3e; abdomen noir à l'extrémité .... *T horus* nov. spec.

— Pas de peigne rudimentaire; abdomen souvent entièrement rouge .... *T luxuriosus* Morice

5. Peigne du tarse antérieur bien développé; les épines situées à l'extrémité du 2e article dépassent l'apex du 3e 6

— Peigne du tarse antérieur absent ou moins développé; les épines de l'extrémité du 2e article atteignent tout au plus l'apex du 3e 11

6. Echancrure des mandibules très grande (comme chez la ♀) .... *T buyssoni* Morice

Echancrure des mandibules plus petite (comme chez la ♀) 7

7. Eperons des tibias postérieurs et pilosité comme chez la ♀ .... *T. micans* Rad.

— Eperons des tibias postérieurs et pilosité comme chez la ♀; espèces que l'on ne distingue sûrement que par l'étude de l'armature génitale 8

8. Pilosité de la face franchement argentée jusqu'en dessus des insertions antennaires, dorée plus haut; extrémité de l'abdomen noire; pas d'échancrure au milieu du bord antérieur du clypéus .... *T. mycerinus* nov. spec.

— Pilosité de la face presque toujours entièrement dorée ou argentée; abdomen souvent entièrement rouge; souvent une petite échancrure au milieu du bord antérieur du clypéus 9

9. Pilosité du thorax plus développée, cachant complètement la sculpture sur la face dorsale du segment médiaire chez les individus frais; pilosité de la face toujours argentée; distance interoculaire plus courte que la longueur des 2 premiers articles du funicule réunis .... *T. cheops* nov. spec.

— Pilosité du thorax moins développée, ne cachant pas la sculpture, même chez les individus frais; la distance interoculaire égale la longueur des 2 premiers articles du funicule réunis 10

10. Extrémité de l'abdomen noire; pilosité du clypéus dorée; peigne moins

développé .... *T. palopterus* Dhlb.

— Abdomen souvent entièrement rouge; pilosité du clypéus souvent argentée; peigne plus développé .... *T. panzeri* v. d. Lind.

11. Abdomen noir; pattes presqu'entièrement noires; ailes antérieures fortement enfumées .... *T. chephren* nov. spec.

— Abdomen et pattes au moins en partie rouges; ailes souvent hyalines .. 12

12. Ailes antérieures jaunâtres au milieu; palpes et langue longs .... *T. longipalpis* nov. spec.

— Ailes antérieures hyalines ou enfumées régulièrement sur toute leur surface; palpes et langue courts; espèces que l'on ne distingue sûrement que par l'étude de l'armature génitale 13

13. Ailes antérieures en général nettement enfumées; pas de pruinosité argentée à l'abdomen .... *T. gracilicornis* Mercet

— Ailes antérieures pas ou peu enfumées; en général des bandes de pruinosité argentée à l'abdomen 14

14. Abdomen noir à l'extrémité; peigne plus développé .... *T. palopterus* Dhlb.

— Abdomen souvent entièrement rouge; peigne moins développé .... *T. pygidialis* Kohl

15. Abdomen entièrement noir 16

— Abdomen au moins en partie rouge 31

16. Segment médiaire et base du premier tergite recouverts d'une abondante pilosité laineuse; pilosité de la face dressée et presque toujours en partie noire ou brune .... *T. albocinctus* Lucas

— La pilosité du segment médiaire et, lorsqu'elle existe, de la base du premier tergite n'est pas laineuse; pilosité de la face jamais brune ou noire 17

17. Tibias plus ou moins rouges 18

— Tibias entièrement noirs 23

18. Le bord antérieur du clypéus forme au milieu un angle très prononcé 19

— Bord antérieur du clypéus tronqué ou arrondi 20

19 Côtés du segment médiaire en général finement striés; échancrure des

fémurs antérieurs portant au fond une petite lamelle verticale .... *T. julliani* Kohl

— Côtés du segment médiaire non striés ; pas de lamelle dans l'échancrure des fémurs antérieurs .... *T. abjectus* Kohl

20. La distance interoculaire égale la longueur des 3 premiers articles du funicule réunis ; extrémité des tergites jaunâtre, décolorée .... *T. fasciatus* Morice

— La distance interoculaire égale au plus la longueur des 2 premiers articles du funicule ; extrémité des tergites non décolorée 21

21. Echancrure des fémurs antérieurs rudimentaire ; base du premier tergite munie d'une pilosité dressée .... *T maidli* nov spec.

— Echancrure des fémurs antérieurs profonde ; base du premier tergite sans pilosité dressée 22

22. Tarse antérieur sans peigne rudimentaire ; des espaces (mats) entre les points sur le mésonotum ; taille plus faible .... *T. mantivora* nov. spec.

— Tarse antérieur avec un peigne plus ou moins développé ; pas d'espaces entre les points sur le mésonotum ; taille plus grande .... *T. grandissimus* Gussak.

23. Mésopleures sans suture épisternale ; cellule radiale très fortement tronquée à l'extrémité .... *T. imperfectus* nov. spec.

— Une suture episternale aux mésopleures ; cellule radiale moins fortement tronquée 24

24. Côtés du segment médiaire brillants, avec une ponctuation très fine et espacée ; face à sculpture très fine, d'aspect soyeux . .. *T. plicosus* Costa

— Côtés du segment médiaire plus ou moins nettement striés ; face ponctuée ou chagrinée 25

25. Articles du funicule à peine plus longs que larges, avec, sur la ligne dorsale une limite nette entre la face antérieure, plus mate, et la face postérieure, plus brillante .... *T. cabrerai* Mercet

— Articles médians du funicule nettement plus longs que larges, leur face antérieure et postérieure à sculpture semblable 26

26. Tarse antérieur avec un peigne formé d'épines blanches ; mésopleures à ponctuation peu nette en arrière 27

— Tarse antérieur dépourvu de peigne ; mésopleures à ponctuation nette sur toute leur surface 29

27. Vertex très large et concave vu de face; mésopleures mates; mésonotum très brillant, avec quelques points isolés, etc. .... *T. priesneri* nov. spec.

— Vertex plus étroit, non concave; mésopleures brillantes; mésonotum à ponctuation plus dense, etc. 28

28. Articles du funicule plus longs .... *T. filicornis* Kohl

— Articles du funicule plus courts .... *T. helveticus* Kohl

29. Clypéus formant un angle net au milieu de son bord antérieur .... *T. nitidus* Spin.

— Clypéus ne formant pas d'angle au milieu de son bord antérieur 30

30. Ponctuation plus fine et plus serrée .... *T. tarsinus* Lep.

— Ponctuation plus forte et plus espacée; mandibules souvent en partie jaunâtres .... *T. nitidior* nov. spec.

31. Le plus grand éperon des tibias postérieurs avec des dents espacées et très fortes; mésonotum avec une forte sculpture aréolée; ailes antérieures avec une bande enfumée .... *T. schmiedeknechti* Kohl

— Le plus grand éperon des tibias postérieurs avec, comme d'habitude, des dents fines et serrées; mésonotum ponctué; ailes antérieures sans bande enfumée 32

32. Tibias entièrement noirs .... *T. pectinipes* L.

— Tibias au moins en partie rouges 33

33. Ailes, sauf leur base et leur bordure, jaunâtres; face fortement convexe. revêtue d'une dense pilosité dorée .... *T. isis* nov. spec.

— Ailes hyalines ou légèrement et uniformément et légèrement enfumées 34

34. Premier sternite caréné; distance interoculaire faible; tempes pratiquement absentes dans le haut 35

— Premier sternite non caréné; distance interoculaire plus grande; tempes plus ou moins développées 36

35. Mésonotum et scutellum brillants, avec des espaces entre les points .... *T. osiris* nov. spec.

— Mésonotum et scutellum mats, sans espaces entre les points .... *T. grandissimus* Gussak.

36. Le bord antérieur du clypéus forme au milieu un angle très prononcé;

pilosité de la tête et du thorax relativement peu développée ....
.... *T. julliani* Kohl

— Le bord antérieur du clypéus ne forme pas d'angle au milieu ; pilosité de la tête et du thorax très dense 37

37. Face moyennement bombée .... *T. vestitus* Kohl

— Face très fortement bombée .... *T. deserticola* nov. spec.

GROUPE DE *PANZERI* V. D. LIND.

Caractérisé surtout par la forme des pièces buccales Labre dépassant nettement le bord antérieur du clypéus lorsque les pièces buccales sont repliées, arrondi ou pointu en avant, bombé. Galea des maxilles nettement plus longue que large, presque aussi longue que le scape sans son bouton articulaire. Sculpture toujours fine.

Groupe difficile. Pour les ♂♂, l'étude de l'armature génitale est souvent indispensable.

Tachysphex panzeri v. d. Lind.

Morphologiquement, la ♀ se reconnait en général à la forme du bord antérieur du clypéus et à son aire pygidiale allongée, microscopiquement chagrinée. La pilosité est relativement peu développée. L'abdomen peut être plus ou moins noir à l'extrémité ou entièrement rouge (var *oraniensis* Lep.). Taille très variable (8-19 mm.).

Le ♂ est souvent difficile à distinguer des espèces voisines. Comme beaucoup d'entre elles, il porte un peigne rudimentaire assez développé au tarse antérieur.

Espèce répandue dans toute la région paléarctique. En Egypte, elle habite généralement les régions sablonneuses ou désertiques depuis le littoral et jusqu'à Assouan, pendant les mois d'Avril à Octobre

Tachysphex cheops nov. spec.

Espèce voisine de *panzeri* v. d. Lind.

La ♀ s'en distingue par l'aire apicale du clypéus plus courte et plus bombée, les antennes plus longues, la distance interoculaire au vertex plus courte, les fémurs plus épais, les tarses moins grêles, l'aire pygidiale souvent plus brillante, mais à surface plus irrégulière, la pilosité plus développée sur la face et le thorax.

Le ♂ s'en distingue par la pilosité plus développée sur la tête et le thorax, par la distance interoculaire plus courte. Les 3 premiers tergites sont recouverts d'une pruinosité argentée assez dense, tandis que sur les sui-

vants, elle est brun foncé, ce qui donne à l'abdomen un aspect bicolore nettement tranché. Armature bien différente de celle de *panzeri* v. d. Lind.

Type (♀) : Route de Suez, 19.X.1935 (collection A Mochi); allotype (♂) : El Arish (Sinaï), 4.IX.1930 (collection A. Alfieri).

Outre l'Egypte (mêmes habitat et époques que pour *Tachysphex panzeri* v. d. Lind.) et le Sinaï, je connais cette espèce de Cyrénaïque.

Tachysphex buyssoni Morice

Espèce ressemblant, à première vue, aux deux précédentes (*panzeri* v. d. Lind. et *cheops* nov. spec.), mais s'en distinguant immédiatement par l'échancrure très large des madibules; la partie basale, avant l'échancrure, n'est pas plus longue que large et se termine par un angle proéminent.

J'ai vu les types de cette espèce décrite d'Egypte et retrouvée au Sinaï (Wadi Mitla). Régions sablonneuses ou désertiques, d'Avril à Juillet.

Tachysphex micans Radoszkowski

Reconnaissable à sa pilosité très développée et à la structure du grand éperon des tibias postérieurs : les dents sont beaucoup plus fortes et moins serrées que chez les autres espèces du groupe.

Espèce que l'on rencontre surtout dans l'Asie occidentale (Turkestan).

J'ai précédemment étudié des spécimens de la collection Radoszkowski.

Egypte : Route de Suez, 4me Tour, 20.IV.1914 (collection Ministère de l'Agriculture); Katta, 10.VII.1935 (collection A. Alfieri). — Sinaï: Wadi Feïran, 28.V.1935 (collection A. Alfieri).

Tachysphex chephren nov. spec.

Bien reconnaissable à sa coloration noire et ses ailes enfumées. Articles du funicule plus longs que chez *panzeri* v. d. Lind.. Mésonotum et scutellum assez brillants, avec une ponctuation très fine.

Type (♀) : Wadi Hoff, 18.VIII.1925 (collection A. Alfieri); allotype (♂) : Wadi Hoff, 18.VIII.1925 (collection A. Alfieri).

L'espèce semble confinée à l'Egypte, mais il existe dans le nord-ouest de l'Afrique une espèce ayant tout à fait le même aspect : *notogoniaeformis* Nadig.

Tachysphex pygidialis Kohl

La ♀ se distingue de *panzeri* v. d. Lind. par son aire pygidiale plus large et brillante, ainsi que par la forme du bord antérieur du clypéus qui montre près de ses angles latéraux un petit décrochement caractéristique, disparaissant souvent chez les individus usés.

Le ♂ se distingue de celui de *panzeri* v. d. Lind. par le peigne rudimentaire du tarse antérieur absent ou très peu développé. Il est souvent difficile à distinguer de certaines espèces et l'étude de l'armature génitale est souvent nécessaire.



Fig. 1. — *Tachysphex pygidialis* Kohl : Bord antérieur du clypéus de la femelle.

Espèce que l'on rencontre dans une grande partie de la région paléarctique. En Egypte, elle s'étend depuis le littoral méditerranéen jusqu'à Assouan, de Mars à Septembre.

La forme habituelle de l'Egypte correspond à *nattereri* Kohl dont j'ai vu le type. Elle se distingue de la forme européenne par son abdomen entièrement rouge et par l'absence totale de stries aux côtés du segment médiaire.

J'ai placé à la suite des *pygidialis nattereri* Kohl cinq ♀♀ qui sont un peu différentes. Les deux premières ont une aire pygidiale plus étroite, des redents peu marqués au clypéus et l'extrémité de l'abdomen noire ; les trois autres ont l'abdomen entièrement rouge, mais l'aire apicale du clypéus est plus bombée et la distance interoculaire plus courte. Espèces ou simples variétés ?

Tachysphex gracilicornis Mercet

Espèce voisine, morphologiquement, de *pygidialis* Kohl. Le ♂ ne s'en distingue souvent que par la structure de son armature. La ♀, par contre, se reconnaît facilement à ses ailes enfumées. Clypéus sans redents. Côtés du segment médiaire en général avec quelques stries nettes.

Espèce que l'on rencontre surtout en Algérie et au Maroc. Le seul individu que j'ai vu d'Egypte provient de Solloum, Avril 1920 (collection A. Alfieri).

Tachysphex palopterus Dahlb.

Espèce très difficile à définir. Le ♂, dont j'ai vu le type, se distingue de *pygidialis* Kohl par son peigne en général un peu plus développé. L'abdomen est noir à l'extrémité, ce qui le distingue de la plupart des *panzeri* v. d. Lind. d'Egypte. L'étude de l'armature génitale est ici indispensable.

J'ai attribué provisoirement comme ♀♀ à ces ♂♂ des individus qui se distinguent de *pygidialis* Kohl par l'aire apicale du clypéus plus courte et plus bombée, sans redents au bord antérieur. L'aire pygidiale est large, parfois un peu chagrinée. Coloration variable.

Il est évident que de nouvelles recherches seraient nécessaires pour tirer définitivement cette espèce au clair.

Vu une demie douzaine d'individus provenant des régions désertiques en bordure du Caire, capturés de Mars à Octobre, et un exemplaire de Solloum (12.IX.1917). J'ai également vu des ♂♂ de Tunisie et de Biskra.

Tachysphex mycerinus nov. spec.

La ♀ est caractérisée par ses formes ramassées, ses pattes courtes, son clypéus sans échancrure médiane, son aire pygidiale large, très brillante et très bombée.

Le ♂ est souvent difficile à distinguer de *panzeri* v. d. Lind. et de *palopterus* Dahlb.. Il porte un peigne rudimentaire au tarse antérieur; le bord antérieur du clypéus est proéminent. Pilosité de la face argentée dans le bas dorée dans le haut (ce que l'on rencontre aussi chez d'autres espèces).

Type (♀): Le Caire; allotype (♂): Massara, 24.IV.1914 (collection du Ministère de l'Agriculture). — Divers autres individus, capturés de Mars à Octobre, provenant des régions désertiques des environs du Caire.

L'espèce se retrouve en Tunisie.

Tachysphex longipalpis nov. spec.

Pièces buccales très allongées, en particulier les palpes et la langue. (Je n'ai pas pu voir, chez la seule ♀ que j'ai examinée, si la langue était aussi longue que chez le ♂). Abdomen rouge, sans pruinosité, ce qui lui donne un aspect particulier. Clypéus de la ♀ sans échancrure au milieu du bord antérieur. Chez le ♂, l'échancrure de la base des fémurs antérieurs est très peu profonde; le peigne du tarse est peu développé.

Type (♀): Giza, 3.VIII.1925 (Collection A. Alfieri); allotype (♂): Choubrah, 30.VI.1926 (collection A. Alfieri). — Divers autres individus capturés dans les régions désertiques ou sablonneuses des environs du Caire, de Février à Juin.

Autres espèces du groupe de *panzeri* v. d. Lind.

N° 1. — Espèce aff. *panzeri* v. d. Lind : Se distingue, de *panzeri* v. d. Lind., par l'aire pygidiale qui est brillante, plus nettement bordée et presque plane. Pruinosité abdominale assez développée.

Une ♀, Hélouan, 21.IV.1934 (collection A. Alfieri); Helouan, 24.IV.1934; Khanka, 27.V.1914; Ikinghi Mariout, 16.V.1915 (collection Ministère de l'Agriculture).

N° 2. — Espèce aff. *cheops* nov. spec. : S'en distingue par la taille plus faible, les téguments du thorax et du segment médiaire plus brillants. Le mésonotum présente une ponctuation fine et serrée.

Une ♀, Aboukir, 4.VII.1912 (collection A. Alfieri).

N° 3. — Espèce du groupe de *panzeri* v. d. Lind. : Ressemble comme coloration à *panzeri oraniensis* (Lep.) Kohl. S'en distingue par la pilosité du thorax plus développée et jaune; sur l'abdomen aussi, la pruinosité est jaune et, de ce fait, ne forme pas de bandes nettement visibles. Aire pygidiale plus étroite et plus brillante.

Une ♀ du Wadi Hussein, 1.VI.1919 (collection Ministère de l'Agriculture).

N° 4. — Espèce du groupe de *panzeri* v. d. Lind. : Très probablement le ♂ et la ♀ d'une même espèce, mais en mauvais état Taille faible. Clypéus jaune. Abdomen brun-rouge, avec l'extrémité des tergites décolorée et une pilosité assez développée, surtout sur le premier tergite.

Un ♂ du Fayoum, 6.VI.1931 (collection A. Mochi); une ♀ du Wadi Hussein, 31.V.19 (collection Ministère de l'Agriculture).

N° 5. — Espèce aff. *pygidialis* Kohl : Abdomen noir; 3e cellule cubitale très large. Armature différente de celle de *pygidialis* Kohl.

Un ♂, Wadi Um Biar (à l'est de Kosseir), 17.II.1924 (collection Ministère de l'Agriculture).

N° 6. — Espèce du groupe de *panzeri* v. d. Lind. : Aspect d'un petit *panzeri* v. d. Lind.. Armature différente.

Un ♂, Gebel Asfar, 31.V.1936 (collection A. Mochi).

N° 7. — Espèce aff. *cheops* nov. spec. : S'en distingue par la taille plus faible, le clypéus sans échancrure, le funicule ferrugineux, la pilosité du thorax plus développée.

Une ♀, Ismailia, 29.VII.1925 (collection A. Alfieri).

Groupe de *LUXURIOSUS* Morice

Le labre et les pièces buccales sont comme dans le groupe de *panzeri* v. d. Lind.. Distance interoculaire au vertex grande. Sculpture plus forte que dans le groupe *panzeri* v. d. Lind.. Pas d'échancrure au fémur antérieur du ♂, ce qui distingue ces espèces de tous les autres *Tachysphex* paléarctiques. Elles ne se retrouvent pas dans le reste de l'Afrique du Nord.

Tachysphex luxuriosus Morice

La ♀ a l'abdomen entièrement rouge, de même que les pattes (chez un individu du Musée de Berlin, les téguments sont entièrement rouges). Pilosité très développée, cachant presqu'entièrement la sculpture de la tête et du thorax chez les individus frais. Aire pygidiale peu nettement bordée.

Les autres caractères morphologiques semblables à ceux de toutes les espèces du groupe. Comparée avec le type de Morice.

Les ♂ a les pattes en partie noires. Le tarse antérieur porte des épines parfois assez longues, mais ne formant pas de véritable peigne : il n'y a qu'une épine à l'extrémité des articles 1 et 2.

Fayoum, Hélouan, régions désertiques ou sablonneuses aux environs du Caire, d'Avril à Juin.

Tachysphex horus nov. spec.

♀ : Extrémité de l'abdomen plus ou moins obscurcie. Pilosité moins développée que chez le précédent. Pattes en bonne partie noires.

Morphologiquement, se distingue à peine de *luxuriosus* Morice : les côtés du segment médiaire semblent en général striés ; l'aire pygidiale est plus nette.

♂ : Je considère comme ♂ de ces ♀♀ des individus qui se distinguent des précédents par la couleur noire plus étendue et la pilosité moins développée. Ils s'en distinguent surtout par la présence d'un peigne rudimentaire beaucoup plus développé au tarse antérieur. L'armature est différente.

Type (♀) : Heliopolis, 28.IV.1913 ; allotype (♂) : Assiout, 31.III.1917 (collection Ministère de l'Agriculture) ; Fayoum, Route de Suez, Abou Rouache, Gebel Asfar, etc., de Mars à Octobre.

Autres espèces du groupe de *luxuriosus* Morice

N° 8. — Un ♂ et des ♀♀ semblent appartenir à la même forme. Coloration encore plus foncée que chez *horus* nov. spec. et pilosité moins développée. Tarse antérieur du ♂ avec un peigne. Armature différente de celle de *horus* nov. spec.. Semble être une bonne espèce.

Gebel Asfar, 29.III. 1937 et Fayoum, 8.III.1936 (Collection A. Mochi).

N° 9. — Coloration comme chez *luxuriosus* Morice, pas de peigne au tarse antérieur, mais armature ressemblant à celle de *horus* nov. spec.

Un ♂, Ezbet Nahlé, 12.VII.1936 (collection A. Mochi).

N° 10. — Coloration comme chez *horus* nov. spec., mais pas de peigne. Armature spéciale.

Un ♂, Meadi, 7.VI.1912 (collection Ministère de l'Agriculture).

GROUPE DE *BICOLOR* BR. (= *SPOLIATUS* GIR.)

Ne semble pas représenté en Egypte. Je connais cependant de Cyrénaïque une espèce nouvelle, qui se distingue de *spoliatus* Gir. (qui doit se nommer *bicolor* Br.) par ses pattes entièrement noires et son mésonotum brillant. Peut-être retrouvera-t-on cette forme en Egypte.

GROUPE DE *FLUCTUATUS* GERST.

J'ai défini dans mon travail sur les *Tachysphex* de France ([2]) les caractéristiques de ce groupe (premier sternite caréné, deuxième sternite avec une plateforme à la base, etc.). J'ajouterai qu'à partir de ce groupe, les espèces ont toutes le labre peu développé, presqu'entièrement caché par le clypéus et que la galea des maxilles est courte.

Tachysphex mantivora nom. nov.

(=*fluctuatus* Kohl, nec Gerst.)

Abdomen entièrement noir dans les deux sexes.

♀ : Bord antérieur du clypéus tronqué droit, avec une petite échancrure médiane. Ponctuation du mésonotum plus ou moins dense. Aire pygidiale assez fortement bombée, à bords latéraux peu nets.

♂ : Echancrure du fémur antérieur profonde. Tarse antérieur sans peigne.

Toute la région méditerranéenne.

Egypte: Alexandrie, Aboukir, régions désertiques aux alentours du Caire, Fayoum, d'Avril à Novembre. — Sinaï : Ein Moussa, en Septembre.

Tachysphex maidli nov. spec.

Abdomen entièrement noir dans les deux sexes.

Se distingue de *mantivora* nom. nov. par ses téguments plus mats sa pilosité plus développée, en particulier sur les fémurs et sur le premier tergite, la ♀ de plus par le bord antérieur du clypéus plus arqué, l'aire pygidiale moins bombée et plus nettement bordée, le ♂ par l'échancrure très rudimentaire de ses fémurs antérieurs et par la présence d'un peigne rudimentaire à son tarse antérieur.

Type (♀): El Arish (Sinaï), 20.V.1921 ; allotype (♂): Helouan 27.V.1930 (collection A. Alfieri). — Mariout, Damiette, régions désertiques aux alentours du Caire, de Mars à Août.

Se retrouve en Cyrénaïque et au Maroc.

Tachysphex grandissimus Gussakovskij

Je crois pouvoir rapporter à cette espèce, décrite de Perse, les individus présentant les caractères suivants :

L'abdomen de la ♀ est rouge à la base, celui du ♂ noir ou ferrugineux très foncé sur les premiers tergites.

([2]) Jacques de Beaumont : Les *Tachysphex* de la faune française *(Annales de la Société Entomologique de France*, Vol. CV, 3e trim., 1936, pp. 198-199).

Se distingue des deux précédents par sa taille plus forte, par la ponctuation très dense du mésonotum, la pilosité plus développée. Chez la ♀, le bord antérieur du clypéus est à peine échancré au milieu, l'aire pygidiale est nettement rétrécie en arrière. Chez le ♂, l'échancrure des fémurs antérieurs est nette, le peigne du tarse antérieur est peu développé.

Egypte: Régions désertiques ou sablonneuses aux environs du Caire, Oasis de Dakhla (désert libyque), de Mai à Septembre. — Sinaï : Romani, 14.IX.1916.

Egalement connu de la Perse, de la Cyrénaïque et du Maroc.

(Tachysphex sordidus Dahlb.)

Cette espèce, dont j'ai vu le type, a été décrite d'Egypte par Dahlbom. Cependant, comme tous les autres exemplaires que j'ai vus provenaient de Chypre ou de Rhodes, je pense qu'il y a erreur sur la provenance, erreur d'autant plus vraisemblable que la collection Hedenborg, d'où l'espèce a été décrite, contient surtout des spécimens d'Egypte et de Rhodes. Comme il est cependant possible que l'espèce puisse se retrouver en Egypte, je signale ses particularités :

Très voisine de *grandissimus* Gussakovskij. Chez la ♀, la base de l'abdomen est d'un rouge très sombre, chez le ♂, elle est en général noire. Taille en moyenne un peu plus faible que chez *grandissimus* Gussakovskij ; pilosité moins développée : ponctuation du mésonotum moins dense. Chez la ♀, les tempes sont plus développées en arrière des yeux que chez les espèces voisines ; l'aire apicale du clypéus est également plus développée ; son bord antérieur présente une petite dent près des angles latéraux, eux-mêmes saillants. Le ♂ se distingue de celui de *mantivora* nom. nov. par sa distance interoculaire plus faible et par le peigne rudimentaire du tarse antérieur plus développé.

(Tachysphex costai Destef.)

Je ne connais pas de spécimens égyptiens de *Tachysphex costai* Destef., mais comme cette espèce se trouve en Cyrénaïque, il est possible qu'on la rencontre aussi en Egypte.

Morphologiquement, très voisine de *mantivora* nom. nov., mais la base de l'abdomen est rouge dans les deux sexes.

Pourtour de la Méditerranée.

Tachysphex osiris nov. spec.

♀ : Téguments en grande partie ferrugineux. Pilosité argentée extrêmement dense sur la tête et le thorax. Face assez fortement bombée. Autrement assez semblable morphologiquement aux espèces précédentes.

♂ : Je n'ai pas vu d'individus frais. Tous ceux que j'ai étudiés avaient la pilosité en grande partie arrachée, mais cette pilosité semble en tous cas être beaucoup moins développée que chez la ♀. Ne sont rouges qu'une partie des fémurs, les tibias et les tarses, les premiers tergites abdominaux. Le ♂ est voisin de celui de *costai* Destef. ; il s'en distingue par la présence d'un peigne au tarse antérieur et par la distance interoculaire plus grande.

Une ♀ d'Assouan, 3.XI.1921 (collection A. Alfieri), est le seul représentant de l'espèce pour l'Egypte. Les autres spécimens étudiés proviennent du désert nubique, de Cyrénaïque et du sud de l'Algérie.

Tachysphex isis nov. spec.

Devrait former un groupe à part. L'espèce se distingue en effet des précédentes par l'absence de carêne longitudinale au premier sternite et l'absence de franges à l'extrémité des sternites du ♂. La structure générale du corps, la nervulation, etc., la rapprochent cependant des autres espèces du groupe de *fluctuatus* Gerst.

La ♀ ressemble au premier abord, par la pilosité très développée de sa tête et de son thorax, à *osiris* nov. spec. Elle s'en distingue cependant facilement, outre les caractères cités ci-dessus, par la face beaucoup plus bombée et par la forme du clypéus.

Le ♂ est très différent de la ♀. La pilosité est en effet beaucoup moins développée, les ailes sont en partie enfumées. La structure du corps très semblable et la concordance des lieux de capture me font croire cependant qu'il s'agit bien du ♂ des ♀♀ ci-dessus.

Type (♀) et allotype (♂) : Wadi Rishrash, 12.V.1935 (collection A. Alfieri).

Cette espèce se retrouve en Cyrénaïque.

Groupe de *SCHMIEDEKNECHTI* Kohl

Se rapproche du groupe précédent par plusieurs caractères, mais s'en distingue très nettement par la sculpture du thorax et par les dents très fortes du grand éperon des tibias postérieurs.

Tachysphex schmiedeknechti Kohl

Outre les particularités du groupe, on reconnaît facilement cette espèce à ses ailes enfumées avant l'apex. Trompé par le dimorphisme sexuel de coloration, Kohl a décrit séparément le ♂ sous le nom de *psilopus*.

Goubbet El Bous, Galala, Hélouan, Fayoum, Gebel Asfar, Sakkara, Abou Rawash, Oasis de Khargha et de Dakhla, de Mars à Novembre.

Groupe d'*ALBOCINCTUS* Lucas

C'est encore un groupe assez voisin de celui de *fluctuatus* Gerst.. Les espèces sont cependant bien caractérisées par leur abondante pilosité laineuse, surtout sur la face et le segment médiaire. La sculpture de l'aire pygidiale de la ♀ est très particulière.

Tachysphex albocinctus Lucas

(= *ruficrus* Dufour, *syriacus* Kohl, *mantiraptor* Ferton, *heliopolites* Morice ♂ [nec ♀], dont j'ai vu les types).

Espèce très caractéristique et que l'on reconnaît facilement. Chez les ♂♂ la pilosité de la face est en général noirâtre ou brune ; chez les petits spécimens par contre, elle devient blanche (*heliopolites* Morice).

Région méditerranéenne, Afrique.

Faraskour, Gebel Asfar, Giza, Abou Rawash, Oasis de Dakhla, Mai à Novembre.

Groupe de *JULLIANI* Kohl

Il est difficile de donner une définition de ce groupe, caractérisé surtout par une forme particulière de l'armature génitale du ♂. Par le segment médiaire tronqué en arrière, les espèces se rapprochent encore des précédentes. L'aire pygidiale des ♀♀ est en général large et souvent divisée d'avant en arrière en deux zones, différemment sculptées. Chez le ♂ aussi, le 7me tergite est en général large, brillant, à ponctuation espacée. Ils ont tous au tarse antérieur un peigne bien développé.

Tachysphex julliani Kohl

Voir la description dans mon travail sur les *Tachysphex* de France [3]. La ♀ est caractérisée par la structure de son aire pygidiale, le ♂ par son clypéus dont le bord antérieur est prolongé par une petite dent triangulaire aigue et par la présence, au fond de l'échancrure des fémurs antérieurs, d'une petite lamelle, souvent difficile à distinguer. Espèce très voisine de la suivante (*abjectus* Kohl). L'abdomen peut être noir ou plus ou moins rouge.

Région méditerranéenne.

Un ♂, Wadi Hoff, 15.III.1935 (collection A. Mochi) ; 1 ♂, Wadi Abou Handal, 28.III.1918 (collection Ministère de l'Agriculture). - Je n'ai pas vu de ♀ d'Egypte.

(3) Jacques de Beaumont : Les *Tachysphex* de la faune française (*Annales de la Société Entomologique de France*, Vol. CV, 3e trim., 1936, pp. 199-200).

Tachysphex abjectus Kohl

Abdomen entièrement noir. Se distingue de *julliani* Kohl par le mésonotum plus brillant et moins ponctué, les côtés du segment médiaire jamais striés, la ♀ de plus par son clypéus plus aplati, les premiers articles du funicule plus longs, la distance interoculaire plus courte, le ♂ par l'absence de lamelle dans l'échancrure du fémur antérieur.

Asie occidentale, Biskra.

2 ♂♂, Wadi Hoff, 15.III.1935 (collection A. Mochi). — Je n'ai pas vu de ♀ d'Egypte.

Tachysphex vestitus Kohl

Pilosité de la tête et du thorax très dense.

♀ : Clypéus tout à fait aplati. Face assez fortement bombée. Aire pygidiale à sculpture et forme caractéristiques. Chez le ♂ aussi, le clypéus est très plat.

Route de Suez, Kerdacé, Fayoum, Wadi Um Assaad, Wadi Assiouti, d'Avril à Octobre.

Se retrouve dans le sud algérien.

(Tachysphex incanus nov. spec.)

Je ne connais pas cette espèce d'Egypte, mais elle s'y rencontrera peut-être, car on la trouve en Cyrénaïque et dans le sud algérien.

Voisine de *Tachysphex vestitus* Kohl. La ♀ s'en distingue par une pilosité un peu moins abondante et par sa distance interoculaire un peu plus faible. La structure de l'aire pygidiale est très caractéristique : elle est mate, divisée en deux zones par une ligne transversale nette; l'aire basale est fortement granuleuse, l'aire apicale finement striée longitudinalement. Clypéus plus proéminent au milieu de son bord antérieur. Le ♂ (?) se distingue du *Tachysphex vestitus* Kohl par sa distance interoculaire plus courte.

Tachysphex deserticola nov. spec.

Espèce voisine des deux précédentes par la structure générale de son corps, sa coloration, sa pilosité. Les deux sexes s'en distinguent par la face plus fortement bombée, la distance interoculaire plus grande, la ♀ de plus par l'absence de particularités à l'aire pygidiale, le ♂ à la faible échancrure de ses fémurs antérieurs.

Oasis de Kharga, 2 ♀♀ (type et co-type), 19.IV. 1917 (collection du Ministère de l'Agriculture).

(GROUPE DE *LATIVALVIS* THOMS.)

Caractérisé, entre autres, par la structure des tarses. Ne semble pas représenté en Egypte.

GROUPE DE *MEDITERRANEUS* KOHL

Se distingue surtout, des suivants, par la structure de l'armature génitale du ♂ (4).

Tachysphex plicosus Costa

(= *gallicus* Kohl)

Espèce entièrement noire, à sculpture très caractéristique. Voir en particulier l'aspect mat de la face, les fortes stries sur la face dorsale du segment médiaire, les côtés de ce dernier brillants avec une très fine ponctuation, etc.

Région méditérranéenne.

1 ♀, Marg. 7.IV.1910; 1 ♂, Ezbet El Nakhlé, 27.III.1914 (collection A. Alfieri).

GROUPE DE *PECTINIPES* L.,

NITIDUS SPIN. ET *SPECIOSISSIMUS* MORICE

Les espèces appartenant à ces groupes sont difficiles à grouper. Ce sont en somme, les espèces qui n'ont pas les particularités des groupes précédents. Les pièces buccales sont courtes, le clypéus aplati, le segment médiaire tronqué obliquement en arrière, la cellule anale des ailes postérieures étroite à l'extrémité. L'armature génitale des ♂♂ est d'un type assez uniforme. Comme les espèces sont nombreuses, il n'est guère possible de les réunir en un groupe unique et il me semble préférable de faire 3 groupes, basés surtout sur la coloration et la sculpture.

GROUPE DE *NITIDUS* SPIN.

Abdomen et pattes entièrement noirs (tarses plus ou moins ferrugineux). La sculpture du thorax est en général une ponctuation nette sur fond brillant; sur les mésopleures en particulier, il y a presque toujours des points nets. Ceux-ci disparaissent parfois plus ou moins, les mésopleures devenant alors brillantes. Groupe difficile. Dans mon travail sur les *Tachysphex* de France (loc. cit.), ces espèces étaient comprises dans le groupe de *pectinipes* L.

(4) Voir Jacques de Beaumont : Les *Tachysphex* de la faune française (*Annales de la Société Entomologique de France*, Vol. CV, 3e trim., 1936, p. 210).

Dans ce même travail, j'avais distingué trois variétés dans l'espèce habituellement nommée *nitidus* Spin.. Il me semble maintenant que ces variétés sont de bonnes espèces, quoique difficiles à reconnaître. On les trouve, en effet, côte à côte dans presque toute la région paléarctique.

Tachysphex nitidus Spin.

(=*nitidus* var. A de mon travail) (5)

Chez la ♀, la partie apicale brillante du clypéus est aussi longue ou plus longue au milieu que la partie basale ponctuée; la limite entre les deux aires n'est pas toujours nette. Ponctuation de la face très serrée. Le ♂ est reconnaissable à un clypéus qui forme en avant un angle accusé.

Ezbet El Nahlé, Meadi, El Mallah, Fayoum, Dekhela et Ikinghi Mariout, de Décembre à Avril.

Tachysphex tarsinus Lep.

(= *nitidus* var. B de mon travail) (6)

Chez la ♀, l'aire apicale brillante du clypéus est plus courte que l'aire basale pontuée. Ponctuation de la face plus fine. Le clypéus du ♂ n'est pas anguleux. Vertex un peu plus étroit à impression plus nette.

Meadi, Fayoum, Kerdacé, Mansouria, Gebel Asfar, Dekhela (Mariout), d'Avril à Août.

Tachysphex nitidior nov. spec.

(= *nitidus* var. C de mon travail) (7)

Les deux sexes se distinguent de l'espèce précédente par la ponctuation plus forte et plus espacée, en particulier sur la face et les mésopleures. La ♀ se reconnaît encore à son deuxième sternite à ponctuation beaucoup plus étendue; l'impression à la partie antérieure du mésonotum, que je signalais dans mon précédent travail, n'est pas toujours nette. Chez le ♂, les mandibules sont souvent d'un ferrugineux pâle au milieu.

Ces trois espèces sont évidemment difficiles à distinguer, mais l'armature génitale des ♂♂ est très distincte.

1 ♂, Wadi Hoff, 3.VI.1936 (collection A. Mochi); 2 ♀♀, Ezbet El Nakhl, 2.VI.1914 (collection A. Alfieri).

(5) Loc. cit., p. 206.
(6) Loc. cit., pp. 206-207.
(7) Loc. cit., p. 207.

Tachysphex helveticus var. aegyptiacus Morice

La ♀ se distingue des précédents par son clypéus tout à fait aplati et par ses mésopleures brillantes, à peine ponctuées en arrière. Le ♂ a la même sculpture que la ♀ ; on le reconnaît de plus à la présence d'un peigne rudimentaire à son tarse antérieur.

La var. *aegyptiacus* Morice se distingue, de la forme typique d'Europe (*helveticus* Kohl), par la ponctuation beaucoup plus espacée de son mésonotum.

Choubrah, Meadi, Helouan, Ezbet Nahlé, Kerdacé, Gebel Asfar, de Février à Novembre.

Tachysphex filicornis Kohl

Espèce voisine de la précédente par la structure de son clypéus, sa sculpture, la présence d'un peigne au tarse antérieur du ♂. S'en distingue, la ♀ surtout, par ses antennes beaucoup plus longues.

Hélouan, Ezbet Nahlé, Abou Zabal, Gebel Asfar, Avril à Novembre.

Toute la région méditerranéenne, Afrique.

Tachysphex cabrerai Mercet

Petite espèce, à mésopleures très brillantes. Chez la ♀, la face inférieure du scape et l'extrémité de l'aire pygidiale sont en général tachées de ferrugineux. Le ♂ est reconnaissable à la structure particulière de ses articles du funicule (voir mon travail précédent [loc. cit., pp. 209-210]).

Gebel Asfar, Helouan, Cheikh Fadl, de Mai à Octobre.

Tachysphex priesneri nov. spec.

Espèce assez différente des précédentes et bien caractérisée par son mésonotum brillant, la sculpture de ses mésopleures, son vertex large et concave, sa pilosité très développée.

Type (♀) : Oasis de Khargha, 11.III.1924, et allotype (♂) : Oasis de Khargha (Wadi Ginah), 12.III.1924 (collection Ministère de l'Agriculture ; Wadi Um Assaad, 9.IV.1931 (collection A. Mochi).

Se retrouve dans le sud de l'Algérie.

Autres espèces du groupe de *nitidus* Spin.

N° 11. — Deux mâles caractérisés par leurs téguments très brillants, leur clypéus anguleux en avant et la structure de leur funicule : les articles 2, 3 et 4 sont très courts, le 5^e presqu'aussi long que les articles 3+4.

Wadi Hoff, 15.III.1936 (collection A. Mochi).

N° 12. — Un ♂ très voisin des précédents, mais la longueur relative des articles du funicule est normale. Face à ponctuation moins distincte.

Route de Suez, 21.VI.1936 (collection A. Mochi).

N° 13. — Peut-être la même espèce que le précédent, mais la sculpture est un peu différente.

Sinaï: Un individu du Wadi Feïran, 29-30.V.1935 (collection A. Alfieri).

N° 14. — Deux femelles qui me semblent être celles des ♂♂ N° 11 (voir la ponctuation du front).

Wadi Hoff, 15.III.1936 (collection A. Mochi).

N° 15. — Plusieurs femelles qui sont probablement celles du N° 12 (voir la ponctuation du front).

Beni Youssef, 15.IV.1934; Wadi Um Assaad, 8.IV.1934; Gebel Asfar 21 et 22.III.1936 (collection A. Mochi); Massara, 31.III.1916 (collection Ministère de l'Agriculture).

N° 16. — Un ♂ dont l'armature ressemble beaucoup à celle de *tarsinus* Lep., mais l'aspect extérieur est différent : front sans ponctuation nette; un peigne au tarse antérieur, etc.

Ezbet El Nakhlé, 11.III.1934 (collection A. Mochi).

Groupe de *PECTINIPES* L.

Pattes noires. Abdomen généralement rouge à la base Mésopleures sans ponctuation distincte, mates.

(Tachysphex pectinipes L.)

(doit se nommer *pompiliformis* Pz.)

Je ne le connais pas d'Egypte, mais j'ai vu des spécimens de l'Ile d'Adelen (Schmiedeknecht).

Groupe de *SPECIOSISSIMUS* Morice

J'ai placé dans ce groupe, probablement hétérogène, les espèces plus ou moins voisines des précédentes par divers caractères, mais ayant les pattes en grande partie rouges.

Tachysphex speciosissimus Morice

Vertex, vu de face, concave. Ponctuation du mésonotum assez espacée. Un individu de Kafr Hakim, 21.V.1930 (collection du Ministère de l'Agri-

culture) correspond au type de Morice. Un autre exemplaire du Wadi Um Assaad, 9.IV.1934 (collection A. Mochi), avec la coloration noire un peu plus étendue (le vertex peut-être un peu plus étroit), correspond à *redivivus* Kohl. Il me semble cependant que c'est la même espèce. Le mâle est inconnu.

Tachysphex fasciatus Morice

Aspect très caractéristique, dû au bord décoloré des tergites. Sculpture fine. Clypéus de forme caractéristique, etc.. Outre une ♀ du Gebel Asfar, 14.IV.1935 (collection A. Mochi), je n'en ai vu que deux autres, le type de Morice et un individu de Biskra. Au musée de Vienne, il existe un ♂ qui est très probablement celui de cette espèce. Même sculpture et même coloration, mais pattes en partie noires.

Autres espèces du groupe de *speciosissimus* Morice

N° 17. — Espèce voisine de *Tachysphex speciosissimus* Morice, mais taille plus faible et ponctuation du mésonotum plus espacée. Aire pygidiale plus aigue. J'ai vu de Biskra deux individus semblables, mais à abdomen entièrement rouge. De Biskra aussi, j'ai vu deux ♂♂ d'une espèce probablement voisine, caractérisés par un profond sillon longitudinal à la partie antérieure du mésonotum.

Un individu du Wadi Um Assaad, 9.IV.1934 (collection A. Mochi).

N° 18. — Me semblent appartenir tous à la même espèce. Se distinguent facilement des précédents par la pilosité plus développée et par l'aspect mat du thorax, dû à une ponctuation très serrée. Aire pygidiale de la ♀ plus large. Abdomen et pattes rouges.

Borghash, 3.V.1934 (collection A. Alfieri); Sakkarah, Kerdacé et Oasis de Dakhla, Mai et Juin (collection Ministère de l'Agriculture).

GROUPE DE *BREVIPENNIS* MERCET

Groupe présentant une série de caractéristiques. Les mésopleures sont dépourvues de suture episternale. Cellule radiale largement tronquée, 3e cubitale large, pattes très peu épineuses, etc.. Arnold a créé, pour des formes voisines, le genre *Atelosphex*. A mon avis, ce genre ne peut pas subsister, même comme sous-genre. Il y a, en effet, entre ces espèces et celles du groupe de *pectinipes* L., des affinités évidentes.

Tachysphex imperfectus nov. spec.

Outre les caractéristiques du groupe, on reconnaît cette espèce à la forte striation du segment médiaire, à l'aire pygidiale mate. etc.. Chez les ♀♀

d'Algérie et de Tunisie, la coloration rouge est plus étendue, envahissant une partie de la face et des pattes. Je n'ai pas vu des ♂♂ d'Egypte.

Une ♀, Kerdacé, 8.VI.1932 (collection A. Alfieri); une ♀, Gebel Asfar, 4.X.1936 (collection A. Mochi).

Il existe d'autres espèces de ce groupe en Algérie et au Maroc. L'espèce type, *brevipennis* Mercet, se trouve en Espagne et au Maroc.

Groupe d'*HOLOGNATHUS* Morice

Très différent des autres *Tachysphex* et mériterait de former un sous-genre spécial : *Holotachysphex*.

Les particularités sont : mandibules sans échancrure au bord inférieur. Pas de peigne chez la ♀. Ponctuation très forte, en particulier sur l'abdomen. Une carène très accusée sur les côtés du premier tergite et une ébauche de carène semblable aux côtés du deuxième (passage aux *Prosopigastra*).

Tachysphex holognathus Morice

Très facilement reconnaissable aux caractères cités ci-dessus. Ne se trouve, semble-t-il, qu'en Egypte.

Un ♂, Zagazig, 5.VI.1913 (collection Ministère de l'Agriculture); une ♀, Kerdacé, 22.VII.1930 (collection A. Alfieri).

Séance du 18 Décembre 1940

Présidence de Monsieur le Professeur MAHMOUD TEWFIK HIFNAOUI Bey,
Président.

Subvention :

Nous sommes heureux d'annoncer que le Conseil d'Administration de la SOCIÉTÉ GÉNÉRALE DES SUCRERIES ET DE LA RAFFINERIE D'EGYPTE a bien voulu nous octroyer une subvention annuelle de L.Eg. 25.

Nous remercions bien sincèrement le Conseil d'Administration de la Société, ainsi qui son Directeur Général, Monsieur H. NAUS, et leur exprimons ici notre vive gratitude.

Don à la Bibliothèque :

La Société a reçu un lot de 30 brochures diverses offertes par Monsieur A. ALFIERI.

Admission :

Sur la proposition de Messieurs le Professeur H. C. EFFLATOUN Bey et A. ALFIERI, Madame HEATH DAVIES est admise à faire partie de la Société en qualité de membre titulaire.

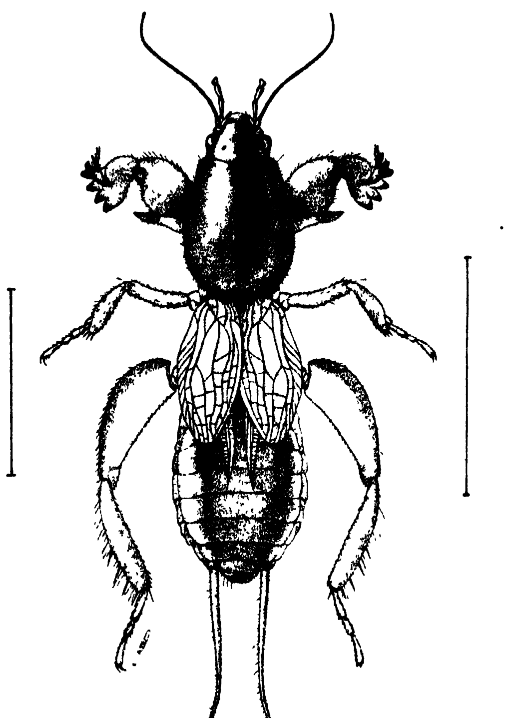
Sur une forme brachyptère inédite de *Gryllotalpa africana* P. de Bauv.

[Orthoptera : Gryllotalpidae]

(avec 1 Figure)

par Antoine Cassab

La Courtilière, en Egypte, était représentée par *Gryllotalpa gryllotalpa* Linné (=*vulgaris* Latr.) et sa forme brachyptère (=*cophta* de Haan), ainsi



Gryllotalpa africana P. de Bauv. : forme brachyptère.

que par *Gryllotalpa africana* P. de Bauv., dont les descriptions, illustrées d'une planche en couleurs, ont été données par l'auteur dans le Bulletin de

la Société Royale Entomologique d'Egypte, 1934, fascicule 4, pp. 421-426.

A cette époque, il n'avait pas été constaté de brachyptérisme chez *Gryllotalpa africana* P. de Bauv.

Des investigations ultérieures ont révélé, dès 1938, l'existence de nombreux individus de *Gryllotalpa africana* P. de Bauv. à ailes ne dépassant pas l'abdomen. Soumis à l'examen de Monsieur le Professeur H. Priesner, Directeur de la Section d'Entomologie du Ministère de l'Agriculture, il fut émis l'hypothèse qu'il s'agissait d'une forme brachyptère de *Gryllotalpa africana* P. de Bauv.. Monsieur L. Chopard, l'éminent spécialiste du Museum National d'Histoire Naturelle de Paris, auquel furent adressés quelques spécimens, confirma ce point de vue.

La biologie de cette nouvelle forme s'est avérée, à l'élevage, être entièrement pareille à celle de l'espèce type.

D'autre part, comme ce fut le cas pour la forme brachyptère de *Gryllotalpa gryllotalpa* Linné, il semblerait que la forme brachyptère du *Gryllotalpa africana* P. de Bauv. tend à remplacer l'espèce typique.

La description de *Gryllotalpa africana* P. de Bauv. forme brachyptère se résume comme suit :

Identique à *Gryllotalpa africana* P. de Bauv., s'en distingue par la longueur des ailes dépassant de peu les élytres au repos

Sur la figure accompagnant cette note, les deux traits indiquent les dimensions naturelles minima et maxima de cette nouvelle forme.

Les premiers individus capturés proviennent des terrains d'alluvions à proximité du Nil des environs de Mansourah ; d'autres exemplaires ont été recueillis aux Barrages de Mehemet Aly et dans toute la province de Calioubieh, en Mars 1939. Sa présence dans la Haute Egypte n'a pas encore été constatée.

A study of the morphology and life history of *Sarcophaga falculata* Pandellé

[Diptera : Sarcophagidae]

(with Plates I-III)

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CONTENTS

I. INTRODUCTION AND ACKNOWLEDGMENTS

A study of the morphology and life history of *Sarcophaga falculata* Pand., the most common species of *Sarcophaga* in Egypt, has been made in the department of entomology. A special stress has been laid on studying the chief breeding media of this species as well as some other common species of *Sarcophaga*.

As far as known it seems that no important account on the life history of *Sarcophaga falculata* Pand. has been given by previous workers. The early stages of other species of *Sarcophaga* have been described in the works of Knipling and Edwards (1936), Smith (1933), Patton and Evans (1929), Greene (1925), Root (1923), Banks (1912), etc..

The writer is greatly indebted to Prof. H. C. Efflatoun Bey under whose supervision this work has been carried out. Thanks are due to Prof. Kamel Mansour for valuable advice and encouragement. I am also very grateful to Dr. H. Salem for his precious suggestions and for the identification of the different species of *Sarcophaga*.

II. MATERIAL AND TECHNIQUE

The breeding was carried out in the laboratory. Some pieces of decaying flesh were placed into a large glass vessel and left in the open, a few drops of water being added from time to time to prevent the flesh from drying. After two days, the vessel was taken to the laboratory and covered with muslin. Within a few days, the early stages were completed and adults emerged.

To study the male terminalia dry *Sarcophaga* flies were relaxed by placing them for about four hours in a glass chamber together with a small piece of cotton containing a drop of glacial acetic acid and kept away from the specimens. The terminalia were then extracted and cut off at their junction with the apparent fourth abdominal segment. This was followed by transferring the terminalia to a solution of 10 % caustic potash in which they were left for about 24 hours. The material was then washed several times with water, dehydrated and examined in clove oil placed in a watch glass.

As regards the female terminalia or larvipositor, it was found necessary to remove the abdomen and place it in a 10 % caustic potash solution for about 24 hours. When the material was soft, the terminalia were extruded by compressing the abdomen and while still in the potash the apparent anterior four abdominal segments were removed. Particular care was taken to avoid the damage of the fifth sternum when detaching it from the fourth. The fifth tergum was also dissected away from the sixth. After being washed several times with water and dehydrated it was finally transferred to clove oil in a watch glass without cover to avoid any pressure. In some cases, however, it was mounted in thick Canada balsam with the ventral surface uppermost and carefully orientated until it was in a such a position that the sterna and other parts were clearly visible and all on a level.

All the drawings of the male and female terminalia illustrated in this paper were made from specimens treated by the above mentioned methods which were found to be very convenient and accurate.

The larvae were studied from microscopical preparations. The first stage larvae were mounted in Faure's fluid, while the second and third stage larvae were killed in hot water, transferred to a 5 % caustic potash solution and left over night. Then they were washed with water, dehydrated and mounted in Canada balsam. The last abdominal segment was studied separately by cutting it with a razor from the rest of the larva and then clearing, dehydrating and mounting it in a hollow slide with its posterior surface uppermost.

III. MORPHOLOGY OF THE ADULT

1. Head Capsule

The head capsule (Plate 1, fig. 1) is broad and nearly trapezoidal in shape in the female, and narrow and roughly triangular in the male. Its anterior surface is strongly convex while the posterior is almost flat and slightly conical. In the male the whole head is smaller than in the female and the compound eyes are more obliquely placed. In the posterior surface of the head capsule, and occupying a median slightly ventral position, is the occipital foramen. This is surrounded by the occipital ring, the lateral parts of which are concave externally and convex internally. From the upper and inner margin of these lateral parts two short chitinous bars are given off. These bend inwards and approach each other internally forming the jugum which thus apparently divides the occipital foramen into an upper and a lower opening, but it really lies in a plane a little anterior to the foramen. The jugum helps in supporting the tentorial membrane On each side of the occipital ring below the jugum there is a small fossa into which a corresponding process from the prothorax fits, forming a support for the head. Posterior to the occipital ring and close to the aperture from which the proboscis depends is the gulo-mental plate which may be regarded as a part of the base of the proboscis. The occipital ring is surrounded laterally by the genae and dorsally by the epicranium. The genae bear the large compound eyes which occupy nearly the whole of the antero-lateral region of the head. On the posterior surface of the head the genae are flat, as they extend from the gulo-mental plate to the epicranium they become distinctly convex. The lower portion of the genae (or the jowls) are provided with numerous genal bristles on the surface. The para-frontals (geno-vertical plates) or the upward continuation of the genae along the inner border of the eyes are yellowish in colour and each is 3/5 to 4/5 of the width of the frontal stripe.

The epicranium on the posterior surface of the head is flat. On the anterior surface it is convex and comprises a number of regions. The area between the large compound eyes of the top of the head and limited below by the ptilinal suture just above the bases of the antennae is the vertex. This contains the three ocelli situated on a slightly raised ocellar triangle which is surrounded by a second triangle — the vertical triangle. In the ocellar triangle there are the divergent ocellar bristles of which one pair situated near the base of the triangle is thicker and longer than the others. On each side of the vertex near the ocular margin and in front of the ocelli and descending to the bases of the antenna there are the frontal bristles which are here decussate and diverging. Lying on each side between the frontal bristles and the ocular margin posteriorly is a stout fronto-orbital bristle. The vertical bristles are composed of a particularly large pair on each side,

situated close to and rather behind the upper inner corner of the eye. Just behind the ocelli there are the post-vertical bristles of different sizes and arranged more or less regularly. Of these, there is one pair which is stout and long. Nearly parallel with the posterior margin of the eye is a row of short and thick black post-orbital bristles, the other hairs on the occipit being white in colour. The part of the vertex between the two rows of the frontal bristles is the frontal (vertical) stripe which is black in colour, and wider in the female than in the male. The median region anterior to and below the vertex is the front which is enclosed by the frontat suture. The front is a depressed plate in the hollow of which the pendulous third antennal segments lies.

The antenna (Plate I, fig. 2) consists of three segments and the arista. Tho first segment is short and is bordered by slender bristles anteriorly. The second is longer and nearly half the third and bears a long stout macrochaeta as well as numerous short and thick bristles on the outer aspect. This segment is cleft on the outer surface and is attached to the third segment by a small conical peg, which fits into a socket, the two surfaces being kept in apposition by ridges and grooves in order to prevent movement and thus to protect the large antennal nerve. The third segment is much larger and provided with numerous scattered round sensoria on the inner aspect. The fourth, fifth and sixth segments are collectively known as the arista and are attached to the third segment slightly on the outer side near the base. The sixth segment, which is very long, is wide basally, narrows apically and bears a number of long spinulae only on its upper and lower sides for a little more than half its length, the distal portion being bare. The spinulae on the lower surface do not extend as far back as do those on the upper surface.

Anterior to and below the front is a narrow strip bounding the anterior edge of the proboscis aperture and is known as the epistome. This may be regarded as the lower edge of the front. At the sides of the front, in the region just behind the epistome, the frontal pit is located, this margin bearing a row of strong macrochaetae, one of which is more strongly developed than the others, and is known as the vibrissa, which lies close to the sides of the epistome. Above the vibrissa and extending to about the middle of the third antennal segment is a number (about 14) of small bristles known as the facial bristles. The epistome is followed anteriorly by the clypeus which is a depressed, chitinous and nearly semi-lunar plate lying in the membrane of the rostrum. Lying transversely above the bases of the antennae and extending downwards on each side of them is the ptilinum the presence of which is indicated externally by the ptilinal suture. Above the bases of the antenna there is a crescentic opening or lunule which marks the invagination of the ptilinum.

2. Proboscis

The proboscis (Plate I, figs 3-9) consists of three main parts : the rostrum, haustellum and labella from above downwards.

The proximal part or rostrum is the largest and is shaped nearly like a truncated cone. It is surrounded by a tough membranous wall which is attached above to the ventral surface of the head capsule. i.e. to the edges of the proboscis aperture, and below being continuous with the walls of the haustellum. The membranous wall of the rostrum is all covered with very minute black bristles which are irregularly scattered. It encloses a large dark brown chitinous plate or the fulcrum which is very similar to the pharyngeal sclerite of the fully mature larva. This plate has nearly the same shape as that of the surrounding membrane of the rostrum. The side walls are somewhat triangular in outline and produced at their upper end into two long and slender cornua or prolongations which are bright yellow in colour and with rounded tips. The side walls or the lateral plates of the rostrum are connected posteriorly and at a short distance from the tips of the cornua by a strong semi-membranous plate which forms the posterior wall of the pharynx. Anteriorly, the side walls are deeply incurved and connected together by a chitinous arched plate or the clypeus which is nearly inverted U-shaped and dark brown in colour. The anterior and lower wall of the pharynx is formed by a thinner granular plate which extends downwards and thus the walls of the pharynx become continuous with those of the pre- and mid-pharynx, the upper end of walls of the pharynx are continuous with those of the œsophagus. The space between the walls of the fulcrum is occupied by the dilator pharyngeal muscles which draw the front wall from the hind and thus the fluid food is sucked up into the pharynx. The maxillary palps are connected to the membrane at the anterior lower surface of the rostrum. They are nearly cylindrical in shape with rounded tips and their distal two thirds are provided with strong short and long bristles Just below the pharynx at the posterior lower ends of the fulcrum is the pre- and mid-pharynx which form a small chamber closed posteriorly by a rectangular semi-membranous plate. The side walls of the chamber consist for the most part of two nearly brown triangular plates of chitin the apices of which are directed anteriorly. This chamber is in communication distally with the food channel that lies between the labrum-epipharynx and hypopharynx ; its posterior wall is connected to the hypopharynx by means of a membrane, and the anterior wall is similarly connected to the epipharynx The proximal end of the chamber is also continuous above with the pharynx to which it is connected by a membrane.

The haustellum is the intermediate portion of the proboscis. It comprises the labium, hypopharynx and labrum-epipharynx. The labium is the posterior part of the haustellum ; it is shaped more or less like a truncated cone with

its apex distal, and is richly provided with long and short bristles especially near the apex. Its posterior and lateral sides are formed by a strong dark brown chitinous plate which is markedly concave in front and is known as the theca or mentum. The anterior wall is formed by a thin semi-membranous plate which is strongly depressed below the surface and thus forms the so-called labial groove in which the labrum-epipharynx and hypopharynx are situated. This groove is bounded on each side by a strong elongate chitinous rod which serves as a support and helps in the articulation of the labium with the labella. At the distal end of the labium where it divides into the labella there is the so called labial salivary gland composed of a nearly rounded mass of cells. Anterior to the labium and fused with its anterior surface proximally is the hypopharynx. This is flat, tongue-shaped, brown in colour and more slender and darker than the labrum-epipharynx. It is produced on the side a little forwards to afford better apposition with the epipharynx. It is also pierced in the middle throughout its length by the narrow salivary duct. Posteriorly, the hypopharynx extends upwards into the rostrum more than the labrum-epipharynx and is connected to the posterior wall of the pre-pharynx by a membrane In front of the hypopharynx is the larger labrum-epipharynx. This is elongate, nearly triangular in shape when seen from the anterior side. Its apex is distal and somewhat rounded. The labrum is anterior to and partly encloses the epipharynx. The former is much larger than the latter and constitutes the anterior and lateral walls of the compound organ. The anterior surface is slightly convex, and the lateral surfaces bend posteriorly and are attached to the sides of the epipharynx by a membrane. The ephipharynx is in the form of a deep groove shaped like an inverted U on the ventral or posterior wall of the labrum-epipharynx. At the proximal end it projects a little into the rostrum and is connected to the anterior wall of the prepharynx. The labrum is also connected at this end to the anterior wall of the rostrum. At the distal end the labrum-epipharynx is slightly flattened, tongue-like, and provided on its ventral surface with several sensory papillae. Lying in the rostrum at the sides is a pair of well chitinized dark brown curved rods (the stipes of some authors). They articulate at their lower end with small depressions at the sides of the proximal broad portion of the labrum. The upper end of each rod is broadened, flattened and semi-lunar in shape.

The labium is distally divided into two oral lobes or labella which form the distal part of the proboscis. At rest each lobe is roughly triangular in outline, but under pressure it becomes nearly oval in shape. Both lobes are markedly separated from each other by a deep and wide longitudinal space which is continuous anteriorly with the labial groove. The outer wall of each lobe is connected proximally to the outer wall of the labium. It is provided with a fringe of well developed long setae as well as numerous

bristles and hairs, some of which are of a sensory nature. The inner walls are slightly larger than the outer and during the process of feeding they become widely apart from each other. The inner wall of each lobe is composed of a thin membrane continuous distally with the outer wall of the labellum. This membrane is traversed by thirty two channels or the so called pseudo-trachea which extend from the periphery to the prestomum or the distal opening of the food channel. Those of the middle which number about eleven are distinctly longer than the upper or lower ones. They also open directly into the prestomum while the others above and below unite to form a collecting channel which opens at the prestomum. The cavity of each channel, which is in fact a depression in the membrane of the inner wall of the labellum, is kept open by means of small incomplete chitinous rings which are transversely arranged and give the pseudo-trachea their annular appearance. Each of these incomplete rings is bifid at one end and simply expanded at the other, and they are arranged close together side by side in such a way that the bifid ends alternate with the simply expanded ends. The membrane is closely attached to all parts of the ring. As a result of this arrangement there are two openings into the channel : an irregular narrow opening or groove running along the whole length of the channel, and a shallow groove perpendicular to the channel and lying between the bifid ends of the chitinous ring. These grooves, the interbifid grooves, are the real openings into the channel and their size limits the size of any particle which the fly can ingest. In *Sarcophaga carnaria* the diameter of the pseudo-trachea according to Graham Smith is 0.02 mm. at the proximal end and 0.01 mm. at the distall end

The prestomal sclerite is a small slightly curved sclerite forming the boundary of the prestomum and serves for the attachment of the pseudo-tracheal membrane and prestomal teeth. Attached to the prestomal (discal) sclerite are the bases of about 9 prestomal teeth on each side. Each tooth is a thin flattened, elongate, piece of chitin which is produced apically into a number of sharply pointed processes. Very near to the prestomal teeth open the collecting channels each by a separate spout-like opening in which the chitinous rings are greatly expanded. The prestomal sclerite serves also to articulate the labella with the chitinous rods which form the antero-lateral boundary of the labial groove. Posteriorly, the labella articulate with the lower or distal end of the mentum by means of the furca or labellar sclerite which is nearly horse-shoe shaped with the limbs less chitinized than the middle part which is almost straight and very thick. This latter part is produced in the middle into a flattened triangular process pointing downwards.

3. Thorax

The general shape of the thorax as seen from the dorsal surface is nearly oval with the anterior end broader than the posterior one. The colour is

yellowish-grey with three dark stripes: one median continued to the tip of the scutellum, and two dorso-central.

The prothorax is much reduced and pressed forwards and downwards by the large mesonotum. It is best seen after the removal of the head. Its dorsal region or the pronotum is composed of two united sclerites with their dorsal sides curved. The lateral regions of the pronotum are in contact with the humeral calli and the prothoracic pleura. Each humeral callus is strongly convexed and is situated in the antero-lateral region of the thorax. It is bounded above by the prescutum of the mesothorax, internally and below by the pleuron of the prothorax, and externally by the large episternum of the mesothorax and the anterior thoracic spiracle. The pleura are comparatively large sclerites forming the lateral regions of the prothorax. They overhang the attachments of the anterior coxae.

In the ventral region of the prothorax, the prosternum is quadrilateral in shape and median in position. Its anterior end is rounded and the sides are nearly parallel. It occupies only a small part of the prosternal area and is bounded by the prosternal membrane. Extending from the posterior end of the prosternum and running obliquely to the lower borders of the anterior spiracle is a strong fusiform process on each side. In front of the prosternum there is the small saddle-shaped sclerite or the inter-clavicle which is provided with two remarkable processes in front covered with long sensory bristles. The inter-clavicle lies ventral to the cephalo-thoracic foramen. On each side of this foramen there is a prominent pocket-shaped sclerite or jugulaire having its convex surface external. Lying immediately below each of the jugulaires is the small rod-like sclerite or the clavicle.

The surface of the prothorax is provided with numerous bristles, of which the humerals are stout and long and two on each callus. The post-humeral bristles are one on either side while the propleurals are five of which only two are strongly developed.

M e s o t h o r a x : The notum of the mesothorax occupies the whole of the dorsal area of the thorax and is composed of the usual sclerites: prescutum, scutum and scutellum. The prescutum forms the anterior part of the dorsal region of the thorax, and its anterior portion bends down almost vertically to unite with the pronotum. The prescutum is nearly conical in shape with its apex which is rounded, proximal. It is separated from the scutum by the complete "mesonotal" suture, and is bounded laterally by the humeral callus and a membranous strip — the dorso-pleural membrane. The scutum is slightly larger than the prescutum and nearly trapezoidal in shape with its anterior and posterior margins parallel, the sides being distinctly convex. It is bounded laterally by the alar membrane and the lateral plate of the postnotum, and posteriorly by the scutellum. The postero-dorsal angle of the scutum is produced into a prominent process — the post-alar callus. The pre-alar callus is

another smaller process situated just above the root of the wing immediately behind the ends of the "mesonotal" suture. The scutellum is the smallest of the three sclerites, about half the size of the prescutum and is nearly triangular in outline. It is separated from the scutum in front by a well marked transverse incision — the transverse or "meso-scutellar" suture. It also overhangs the post-notum (post-scutellum) which chiefly forms the posterior surface of the thorax. The post-notum is composed of three pieces: a large median plate which is nearly rectangular in outline and strongly convex externally, and two lateral plates which are slightly convex and bounded below by the metasternum and spiracles and anteriorly by the pleural region of the mesothorax. The mesosternum is fused with a part of the episternum to form the sternopleuron which is marked in the mid ventral line by a strong suture. Ventrally it is bounded in front by the foramina of the anterior coxae, behind by the foramina of the intermediate coxae and laterally by the large mesopleuron. This forms the whole of the anterior portion of the pleural region. It is quadrilateral in shape and is raised, above and behind, from the surface of the thorax by its deep inflected margins. It is bounded in front by the humeral callus, spiracle and prothoracic pleuron, above by the dorsopleural membrane, and behind by the mesopleural suture The epimeron consists of pteropleuron, hypopleuron and metapleuron. The pteropleuron lies behind the mesopleural suture and below the alar membrane. It is nearly rectangular in shape and it is bounded below and behind by the large hypopleuron. The dorsal side of the pteropleuron is closely connected with sclerites of the anterior portion of the wing base. Its surface is also marked by two slight convexities. The hypopleuron is larger than the pteropleuron and subquadrate in shape and is bounded below by the hind coxa, in front by the sternopleuron and behind by the posterior thoracic spiracle.

The metapleuron is small and more or less fan-shaped. It is bounded anteriorly by the mesopleuron, posteriorly by the lateral plate of the post-scutellum, above by the wing base, below by the posterior thoracic spiracle. The parapteron is a small irregular sclerite situated at the top of the mesopleural suture, and its greater part is internal, only a small triangular portion is visible externally. The costa is a small thin shell-like sclerite situated on the dorsal margin of the epimeron. Its outer surface is convex and directed downwards and outwards and is covered with fine bristles.

The surface of the mesothorarx is provided with several and various bristles. The bristles, which are important in the identification of this species, are the acrostichals which are absent in front of the mesonotal suture and one pair behind it, and the dorso-centrals which are four or five pairs behind the suture, of which the posterior pair is prominent and the rest quite weak. The scutellar apicals are present. Other than these are the sterno-pleural bristles which are three in number: two anterior and one posterior, the most anterior

and posterior ones being much longer and thicker than the middle one. Male scutellum provided with two very long marginal bristles on each side and a pair of smaller crossed apical bristles. In the female the latter bristles are always wanting. A pair of pre-apical scutellars is also present in the males and females. The hypopleural bristles are seven in number and are of moderate length.

In the metathorax, the sternum is also fused with the episternum to form a sternopleuron which is smaller, triangular in shape with its apex dorsal. It articulates in front with the hypopleuron, below with the posterior coxa, and behind with the metathoracic epimeron. This latter is smaller than the sternopleuron and rod-like. It is bounded below by the coxal foramen and behind by the first abdominal segment, its dorsal part coming into contact with the base of the haltere. The metanotum is quite indistinct.

4. Wings

The wings (Plate II, fig. 10) are situated at the sides of the mesonotum and are hinged to processes of the latter by means of the small chitinous axillary sclerites. They are covered with very minute hairs. The anterior margin of the wing is formed by a stout vein, the costa which is provided for most of its length with very short black bristles directed towards the apex of the wing. The second vein or the sub-costa lies behind the costa and joins it at about the end of the proximal third of its length. A small vein — the humeral cross vein — extends between the costa and sub-costa near the base of the wing. Tillyards considers it a veinlet and not a true cross vein. The third main vein or the radius divides into a simple anterior branch R1 which joins the costa about half way along its length, and a primary branch — the radial sector — which apparently gives off two branches namely R2+3 and R4+5. The former represents the coalesced second and third branches, and joins the costa at the apical curve, the latter represents the coalesced fourth and fifth branches and joins the costa shortly before its end. This vein bears anteriorly, shortly before it joins the radio-medial cross-vein about 8 short bristles. The fourth main vein or the media divides into M1+2 which represent the fused first and second branches. and M3+4 which represent the fused third and fourth branches. The M1+2 extends across the middle of the wing and bends forwards with sharp angle, joining the costa near the third vein R4+5 and some distance anterior to the apex of the wing. About half way across the wing there is the radio-medial cross-vein joining R4+5 to M1+2 and cuts off the first posterior cell R5 which is narrowly open from the radial cell R. The third and fourth branches of the media (M3+4) together with an intermedial cross-vein have — according to Tillyard — all fused and formed one vein, which was referred to — according to the old nomenclature — as the postetrior vein. The fifth vein or cubitus

divides into two branches Cu1 and Cu2; Cu1 is fused with M4 to form the longitudinal vein M4+Cu1 which runs to the posterior margin of the wing about half way along the length of the latter. The veins M1+2 and M4+Cu1 are joined by the median cubital cross-vein which cuts off the small triangular medial cell M. The last main vein is the analis, its first branch A1 is longer than the second A2 and both do not reach the margin of the wing thus the first cubital and anal cells are incompletely separated from each other. The analis is joined to the cubitus by the cubito-anal cross-vein.

At the posterior border of the wing there is an incision demarcating a small basal lobe — the alula — which is thick and attached posteriorly to the wing root between the mesoscutum and the lateral plates of the post-scutellum. Proximal to the alula, the membrane is again lobed to form the anti-squama and squama which are thinner than the alula and fringed with minute hairs. At the humeral angle there is the small thickened pad or tegula covered with bristles.

The halter is situated on the sides of the thorax attached to the meta-pleuron above the posterior spiracles. Each is an elongated body with a long cylindrical stem, terminating in a globular end and bears few hairs and small bristles. Numerous sensory pits arranged in rows are found on the base.

5. Legs

The legs (Plate II, fig. 11) are uniform in the females but bear distinctive characters in the males. The three pairs of legs are composed of the typical number of segments. Each consists of coxa, trochanter, femur, tibia, and tarsus. The coxae are elongate and more or less conical in shape and richly provided with long setae. The coxae of the first pair of legs are distinctly larger than those of the second and third pair. The trochanter is a small wedge-shaped segment and nearly similar in the three pairs except with a slight and gradual increase in size from the anterior to the posterior pair. The anterior femora are shorter and stouter in the middle than those of the intermediate and posterior pairs of legs. The middle femora in the males only have a very well developed fringe of long soft hairs on the lower edge basally. Also they are provided with a comb of short spines on the ventral side apically. The hind femora also bear a fringe of long soft hairs along its lower edge as well as stiff bristles posteriorly. The anterior tibiae are slightly shorter than those of the succeeding legs. Each tibia is broader distally and nearly as long as the femur and provided with few long setae, and numerous short ones on the sides. On their inner sides the anterior and middle tibiae are covered with short closely-set, black coloured setae. The hind tibia in the male differs from the fore and middle by the possession of a double fringe of long and soft hairs along most of the ventral side. The tarsus is shorter than the tibia and densely clothed with minute setae. It is divided into five sub-

segments, the first being elongate and about half the entire length of the tarsus. The second and fifth tarsal segments are nearly equal in size and distinctly longer than the third or fourth. The general shape of each tarsal segment is nearly conical with the apex proximal and a stout seta at the base on either sides. The fifth or last tarsal segment bears distally the complicated apparatus known as the foot (Plate II, fig. 12). The dorsal side of the segment is prolonged to form a small projection against which a pair of well developed, orange coloured, curved and identical claws articulate by a small condyle. On the ventral surface of the foot there is the foot plate which is a strongly developed sclerite and divided into two lateral and one median foot plates. The lateral foot plates are nearly triangular in shape with the apex outwards, and the base interrupted by a groove directed towards the apex of the triangle. The median plate is pentagonal in shape with the sides nearly equal. On the ventral side of the claws, and attached to the membrane at the end of the segment, there are the pulvilli one on each side. The pulvillus is nearly triangular in outline with the base distal, and the tent hairs on its ventral surface are well developed. The empodium which lies between and ventral to the pulvilli is a spine-like structure, slightly longer than the pulvilli, and provided with two short bristles on either side of its thick base.

6. Abdomen

The abdomen is nearly conical in shape with its apex distal. It is much broader in the female than in the male. As seen from the dorsal side, the abdomen appears to consist of four distinct segments. The apparent first tergum is in fact a compound segment consisting of the reduced first tergum and the larger and normal second tergum. That is clearly shown by the presence of the two spiracles which belong to the first and second segments, and the two sterna in the ventral surface of the abdomen. Senior-White (1924) considers that the apparent first abdominal tergum is the fused second and third, the true first segment being partially fused with the thorax. Lundbeck (1927) in his comment on Senior-White's conclusions considers that the second and third segments of Senior-White are no doubt only one segment except just the part with the first spiracle (the second of Senior-White) often lying in a separated plate. The abdominal segments succeeding the fifth are greatly modified in both sexes; in the male they form the male genitalia and in the female the larvipositor which will be described later. The second tergum is nearly rectangular in shape with rounded anterior ends. The maximum width occurs in the third tergum which is rectangular in outline and bears weak central bristles. The fourth tergum (apparent third) is trapezoidal in shape and provided with a pair of well developed median bristles. The fifth tergum is nearly conical in shape with rounded apex which carries several strong and thick bristles. The whole dorsal surface of the abdomen is densely covered with minute bristles.

In the ventral surface of the abdomen there are five distinct sterna which are comparatively much smaller than the terga and form a series of narrow plates lying along the mid-ventral line. The first sternum is a small rectangular plate about one third of the size of the second sternum which is the largest of all. The third and fourth sterna are nearly similar in shape, nearly conical with rounded distal apices, only the third is slightly larger than the fourth. The fifth sternum differs in shape from the previous sterna in being square in outline, and is the smallest segment after the first. All the sternites except the first are provided with about five rather long bristles at their distal ends. The fifth sternite is deeply clefts in male and forming two narrow lamellae. The ventral surface of the lamellae is bare. The five abdominal spiracles have a peculiar arrangement. The first and second are situated near the outer edges of the sterna, while the other three spiracles have migrated from the pleural region to the outer edges of the terga.

The larvipositor (Plate II, fig. 13)

The larvipositor (female terminalia) is very short. It is formed by the modified 6th, 7th, 9th and the remains of the 10th abdominal segments, the eighth segment being absent according to Patton. The sixth tergum is a large undivided plate dark brown in colour and armed with a row of strong and thick setae along its distal margin. The sixth sternum is nearly rectangular in outline with its distal margin slightly concave, and provided on each side with a pair of long setae together with a number of very minute hairs. The seventh sternum is also well developed and has a peculiar shape. Its proximal edge is distinctly convex and fits in the concavity of sternum 6. Its distal edge is markedly concave and bears on each side one or two stout setae. The tergum of this segment is incompletely developed and extends as an arched plate. The ninth sternum is a large membranous area pale yellow in colour and not only projecting beyond the end of sternum 7 but surrounding its sides. Its distal margin is also concave and slightly grooved in the middle thus appearing as bilobed. Each lobe bears a single long hair. The shape and structure of the sterna 6, 7 and 8 is of an important diagnostic value for this species. Terga 9 and 10 are wanting and sternum 10 is a small semi-transparent plate, nearly triangular in shape with its apex distal, and the base slightly convex. The whole surface is covered with very minute hairs and few long ones. Lying between this sternum and sternum 9 is the large crescentic genital opening. On either side of sternum 10 there are the anal cerci each of which is provided with numerous long hairs. The spermathecae are long flask-shaped bodies, the neck is long and appear to consist of several rings forming a channel.

The male terminalia (Plate II, figs 14-15)

The male terminalia has recently received a considerable study by different authors namely Senior-White (1924), Lundbeck (1927), Salem (1935) and Patton and Wainwright (1935 and 1936) owing to their importance in the diagnosis and determination of the species of *Sarcophaga.*

The male genitalia proper hang from the ninth segment which is called by Böttcher (1912) the second genital segment (GS2), and by Patton (1935) the 9th tergosternum. The genital segment GS1 of Böttcher is the 7th tergosternum of Patton. These two segments are hidden from view on the ventral surface of the abdomen at rest. They are markedly grooved beneath to receive the male terminalia. The first genital segment is large and dark brown in colour and provided on its posterior edge with an incomplete row of strong bristles. The second genital segment is much smaller than the first and is shining yellow or orange in colour and more densely covered with hairs. The anal cerci (the forceps or superior claspers of other authors) are a pair of boat-shaped structures hanging from the second genital segment. They are nearly united with each other basally and free apically. They are brown in colour except their outer margin which is distinctly black and densely covered with long hairs. The apical part of the cerci is nearly bare. The posterior margin is curved and is produced into a hump, while the anterior is nearly straight. The apex in one of the cerci is broadly blunt pointed while in the other it is sharply pointed.

The accessory plates are formed by a pair of triangular sclerites lying anterior to the anal cerci, having a dark brown colour somewhat lighter in the middle. The anterior margin of each plate is provided with long soft hairs.

The phallosome (theca, penis or aedeagus of other authors) is a complicated system of structures lying anterior to the accecsory plates. It consists of two portions: a basal portion known as the shaft (haft of Böttcher) and an apical portion termed the end piece. The shaft of the phallosome carries two pairs of appendages: the anterior and posterior parameres (anterior and posterior gonapophyses of Lowne, vorder und hinter kaken of Böttcher, and anterior and posterior claspers of Parker). The anterior parameres are longer and slightly darker in colour than the posterior ones. They are also less pointed apically and they bear very minute hairs at their broad basal part. The posterior parameres are sharply pointed apically and carry short bristles on their slightly curved anterior margin near the apex. In both parameres the shape is claw-like. The end piece of the phallosome has been the subject of study by various authors such as Böttcher Parker, Senior-White, Rohdendorf and Salem and was found to be complicated. It is composed of a large basal membranous part from

which hang several chitinous processes apically. This membranous part is nearly conical in shape with its base distal and is markedly swollen anteriorly and provided with transverse striations. It carries distally and posteriorly a semi-membranous and nearly triangular plate of a brown colour. In front of this plate and arising from the hollow of the end piece is a pair of nearly black or very dark brown processes somewhat globular or slightly oval in shape. They lie close to each other in the median line. Outside each of these is a club-shaped process of a larger size and of a uniform dark brown colour. Anterior to this process is a thin curved plate more or less pointed anteriorly and golden yellow in colour. Above this plate and attached to the swollen part of the large basal plate is another curved process which is broad and nearly triangular in outline. Its colour is dirty brown and membranous apically.

IV. LIFE HISTORY

1. Sex ratio and sexual maturity

It has been found by repeated observatitons that the proportion of sexes differs slightly in the different seasons of the year. In the early summer and autumn when the fly breeds extensively and is seen in large numbers in slaughter houses, wholesale meat shops and on decaying animal matter, etc., the number of females exceeds that of the males. In the laboratory, the fly was bred several times in September and October from decaying flesh (of dead body of a dog). The adults which emerged were counted and the ratio of both sexes was as follows :

FEMALE	MALE	TOTAL
18	8	26
16	11	27
22	9	31
8	9	17

In the early spring (February and March) the number of both sexes is nearly equal and sometimes the males may slightly exceed the females in number.

The period extending from the time when the fly emerges from the puparium until it reaches sexual maturity and becomes able to larviposit was determined by carrying out experiments in the laboratory. In each experiment fully mature larvae were placed in a glass vessel the bottom of which was provided with a layer of sand. The larvae were left to pupate and in a

few days the adults emerged. These were transferred to a large glass vessel covered with muslin at the top and containing a few pieces of decaying flesh. The flies were 57 of which 36 females and 21 males. It was found that about 14 of these became sexually mature and were observed to copulate in about three days, and to larviposit two days after at 28-30° C. Others, numbering about 13, reached maturity in about five days and larviposited three days after at the same temperature. In a few cases the duration may be prolonged to ten days. But it is very likely that under natural conditions the period of sexual maturity may be about three or four days or even shorter.

2. Breeding habits and breeding season

In the course of this work a special stress was laid on studying the breeding media of this species as well as some other species of *Sarcophaga* which are of common occurrence. Therefore several observations in the open and laboratory experiments have been made in order to find out the most favourable breeding media of these flies. The breeding substances that have been investigated are the decaying bodies of dead animals, human excreta and dung of different animals. The results obtained from direct observations clearly demonstrate that *Sarcophaga falculata* Pand. mainly breeds in decaying animal matter. Especially in the country, the corpses of horses, donkeys and dogs, etc., are frequently seen exposed in the open and these serve as a very favourable breeding medium for this species especially they last for a long time before they become completely dry. The dead bodies of smaller animals such as cats, rabbits and birds, etc., usually harbour smaller numbers of larvae, and are in addition not highly favoured by the flies for larviposition, probably due to the fact that they desiccate in a short time under the high temperature conditions in this country. The larvae of this fly, as a rule, do not breed in human excreta and never do so in dung. Only in two cases three larvae were found in human excreta of about two days old. *Sarcophaga hirtipes* Wied. which comes next to *Sarcophaga falculata* Pand. in its distribution and abundance in Egypt, has been found to be the only species among the common Sarcophagid flies which breeds extensively in dung especially that of horse. It happened several times while examining heaps of horse dung that this latter was teeming with larvae of this species. The corpses of dead animals, decaying animal matter, etc., attract the larvipositing females in less abundance as compared with dung. Human excreta is slightly favoured by this species as a breeding medium. *Sarcophaga carnaria* Meigen is slightly less abundant than *Sarcophaga hirtipes* Wied.. It breeds chiefly in rotten flesh of any kind. Human faeces or dung is of no importance as breeding substances. Continuous and repeated search showed the complete absence of the larvae of this species in these substances. *Sarcophaga dux* Thomson is much less abundant than *Sarcophaga carnaria* Meigen.

Its chief breeding medium is the decaying animal matter. Human excreta comes next in its power of attraction for the larvipositing females. These are never attracted to dung of any kind.

In the laboratory, experiments have been carried out in which the flies were given the option of the three breeding substances mentioned above. Six glass vessels, two containing decaying flesh of a dead dog, two containing fresh human faeces and two containing fresh horse dung, were left exposed for larviposition. Favourable conditions of humidity were afforded by adding small quantities of water whenever these substances showed any signs of desiccation. After being exposed for about two days the vessels were taken to the laboratory, each was covered with muslin, and the early stages were left to complete the development. When the adults emerged the Sarcophagid flies were sorted out among the other different flies and identified. It should be mentioned that not in every experiment the four species of *Sarcophaga* were obtained. In some cases I had to repeat the experiments six times until I was able to obtain the four species in the same breeding experiment. The temperature ranged between 26 and 29° C. in March. The results of one of the typical experiments is given in the following Table. They are

Larviposition experiments

SPECIES	*SARCOPHAGA* OBTAINED FROM ROTTEN FLESH		*SARCOPHAGA* OBTAINED FROM HUMAN EXCRETA		*SARCOPHAGA* OBTAINED FROM ANIMAL DUNG	
	Vessel 1	Vessel 2	Vessel 3	Vessel 4	Vessel 5	Vessel 6
falculata Pand.	92	124	14	7	-	-
hirtipes Wied.	65	42	33	11	88	35
carnaria Meig	15	54	—	—	—	--
dux Thomson	29	36	18	31	—	—

generally in agreement with those obtained from direct observation, and in addition they emphasize the importance of human excreta as a breeding medium for some species.

As regards the breeding season of *Sarcophaga* it has been found that the breeding activity lasts from March to October but reaches its maximum in the early summer (April and May) and in the autumn (September) when the flies are found in great abundance and breed very extensively in decaying animal matter, etc.. That is evidently due to the favourable temperature in these months of the year which helps in the acceleration of the developmental period. During the summer months (June, July and August), the high temperature renders the breeding activity considerably less In

winter, the flies are not commonly met with and in January they become hardly seen.

3. Larval and pupal stages

The female is viviparous. The embryo develops in the gravid female and is generally deposited within the egg membrane. Just after depositing, the first stage larvae break out and bore into the food material upon which they are deposited. Larvae which are not fully developed will remain within the egg membrane, under favourable conditions, until they are completely developed, otherwise they will easily desiccate and die before they are ready to begin feeding. In several cases the first stage larvae were obtained by squeezing the abdomen of the sexually mature females. The larvae were then kept in water for a few hours until ready for placement on breeding media. The larvae deposited by the females are forced out through the larvipositor with the anterior end foremost. The usual manner of locomotion that follows deposition is with the anterior end forward. The number of larvae deposited by the female ranges between 4 and 8. It was possible to obtain in one of the experiments 57 first stage larvae from 6 gravid females — in other species the number differs considerably (K n i p l i n g and E d w a r d s 1936). The larva, after deposition, disappears in the food material (decaying meat), feeds actively, increases in size, and in about 24 hours moults into the second larval stage at a temperature of 30° C. At 25 ° C. the duration of the first larval stage lasted 30 hours and when the temperature was lowered to 20-23° C. (mainly 21° C.) the duration was prolonged to about 48 hours. The second stage larva assumes a more pronounced activity and in about 3 days at 20-23° C undergoes the second larval moult and changes to the third stage larva. At a slightly higher temperature (25° C.) the duration was shortened to about 2 days, and at 30° C. to about 32 hours. The third stage larva is an active feeder and gradually attains a relatively large size. The average duration of this stage is about 5 days at 25° C. Third stage larvae found on 25.IX.1939 pupated on 28.IX.1939 at 31° C. Others found on 3.X.1939 pupated on 7.X.1939 at 29° C. At lower temperature (in December 1939) the flies were bred and about 30 third stage larvae were obtained on the 25.XII.1939. Some of these pupated on 31.XII.1939, others on 1.I.1940, the rest on 2.I.1940 at about 21° C.

When the larva approaches pupation it turns creamy-white in colour and bores into the sand which was placed at the bottom of the breeding vessels. The duration of the pupal stage is considerably long in the cold months of the year — in January it may be as long as 13 days. Larvae pupated on 2.I.1940 gave rise to the adult on 14 and 15.II.1940 at 19° C. At 25° C. the pupal stage lasted 8 days and at 30° C. 6 days.

The total duration of the life history is thus about 15 days at 25° C,

and about 11 days at 30° C. Probably this relatively long life cycle is attributed to the artificial breeding conditions in the laboratory. Under natural conditions here the duration may be considerably shorter.

4. First stage larva

The first stage larva is very small in the beginning but gradually increases in length as shown by the following measurements: 3.1, 3.5, 3.9, 4.3, 5.4, 6.1, 7 mm. in length. In thickness it also varies from 0.3 to 1 mm. The number of the body segments is apparently twelve of which the anterior five segments are nearly conical in shape, the rest being more or less cylindrical with very slight tapering posteriorly. At the line of junction of each segment to the other — or in other words in each inter-segmental region — there is a complete ring of delicate, finely pointed, hair-like black spines which are arranged more or less in several transverse rows. These increase towards the posterior end of the larva.

There are no anterior spiracles. The posterior spiracles are situated in a pit, and each consists of two relatively wide, nearly straight slits close together and directed more or less vertically.

The head is a small conical structure, divided into two cephalic lobes separated from each other by a narrow groove. Each lobe bears dorsally the two segmented antenna or the sensory papilla. The proximal segment is nearly cylindrical and much thicker than the distal which is nearly conical. Anterior to the antenna and shifted slightly to the outer side is the so-called maxillary palp, composed of minute sensory structures arranged close to each other. Ventrally, there is a large nearly circular area traversed by the food channels of which those in the middle are the longest of all. The last abdominal segment is provided with a deep pit which is surrounded by small conical processes or tubercles situated at the margin of the pit. The rest of the surface of the segment is granular and armed with minute spines. The cephalo-pharyngeal skeleton differs greatly from that of the next stages. It is much slender and less chitinised. The mouth hooks are equal in size and sharply pointed. Their tips are curved downwards. The ectostomal sclerites are very small and lying on the outer side of each mouth hook. The hypostomal sclerite is rather large and more or less well chitinized. Dorsal and more anterior to this sclerite is the epistomal sclerite which seem to be composed of two plates and devoid of the two sensory organs found in *Musca* larva. The pharyngeal sclerite is deeply incised at both ends, the antero-dorsal end is jointed to its fellow by the small dorsal arch or dorso-pharyngeal sclerite. The dorsal cornua are longer than the ventral which are not produced into a hump.

5. Second stage larva

The second stage larva varies from 7 to 12 mm. in length, and 1 to 2.5 mm. in thickness. It generally resembles the first stage larva in shape but exhibits some differences in detail. The spines of the inter-segmental rings are more developed and numerous. The anterior spiracles are present and each consist of 11 to 12 short digitate processes. The posterior spiracles (Plate III, fig. 16) are more developed, the peritreme is wide and the two spiracular plates are larger than in the first stage larva. The inner plate is nearly straight and is now directed outwards, while the outer plate is slightly curved and dorso-ventral. The head of this stage is nearly similar to that of the third stage larva. The last abdominal segment is truncated and the pit in which the posterior spiracles lie is deeper and the tubercles surrounding it are larger than in the first stage larva. The cephalo-pharyngeal skeleton bear much resemblance to that of the third stage larva. The mouth hooks or mandibular sclerites are for the most part well chitinised and black in colour, their posterior portions being dark brown. Ectostomal and accessory stomal sclerites are small and weakly chitinised. The hypostomal sclerite is well chitinised and the transverse bar connecting its two lateral portions is thick and black in colour. The epistomal sclerite is slightly chitinised at the edges and devoid of the two sense organs as in the first stage larva. The pharyngeal sclerite is well chitinised except the upper portion of the dorsal cornua. Posteriorly these cornua are deeply incised. The dorsal arch is still weakly chitinised and dark brown in colour. The pharyngeal sclerite in produced anteriorly into a small slender process which extends dorsal and nearly parallel to the hypostomal sclerite.

6. Third stage larva

In the beginning, the third stage larva measures about 12 mm. in length but gradually increases remarkably until it reaches 25 mm. in the fully mature stage. Its thickness reaches 5 mm. or sometimes more. The head (Plate III, figs 17 and 18) is now well developed and the two cephalic lobes are markedly separated by a deep groove. Each bears the two segmented antenna and the so-called maxillary palp which is composed of several sensillae. In addition to these there is on the ventral side of the cephalic lobe an oval disc with minute sensillae. The food channels are well developed and more numerous. The spiniferous rings (Plate III, fig. 19) are broader than in the previous stages, and the spines are arranged alternately in about ten rows. In the living condition they are all black in colour, in prepared slides most of them appear pale yellow. The prothoracic segment is demarcated anteriorly from the head and form a sort of collar into which the head can be retracted. Maximum width of the larva takes place in the eigth body

segment. The last abdominal segment (Plate III, fig. 20) differs in shape and structure from the other segments. It slightly tapers posteriorly and most of its posterior surface is occupied by the deep pit or cavity in which the posterior spiracles lie. The edge of the cavity is produced dorsally into six conical processes arranged symmetrically three on each side, and ventrally into other six similar processes the middle pair of which is the largest. The ventral edge of the segment is produced into two large conical processes one on each side. Numerous delicate spines occur all around the segment. The anterior or prothoracic spiracles (Plate III, fig. 21) are provided with 12 short finger-like processes. The atrium here is divided into two incompletely separated chambers, each with an opening to the trachea. The two posterior spiracles (Plate III, fig. 22) are well developed and are separated from each other by a little less than half the width of one. The peritreme is dark brown in colour and not uniform in thickness. It incompletely surrounds the entire spiracle, and there is no button. The wall of the peritreme projects inwards to form two processes: an inner short process bifid at its tip and an outer and longer sharply pointed process. These processes strengthen the chitin on which the spiracular slits are situated. The position of the three spiracular plates is very characteristic and is valuable in the identification of the species. The inner plate is slightly curved with its convex side inner and its concave side outer. Its upper portion lies between the inner margin of the peritreme and the inner bifid process. It is directed outwards and downwards. The middle spiracular plate is nearly straight and slightly directed outwards. Its upper portion lies between the inner and outer processes of the peritreme. The outer plate is curved with its concave surface to the inside. It is nearly dorso-ventral in position, its lower half being directed to the inner side of the spiracle.

The cephalo-pharyngeal skeleton (Plate III, figs 23 and 24) of the third stage larva is well developed, strongly chitinised and all the sclerites are nearly black in colour. The mouth hooks or mandibular sclerites are identical and bluntly pointed. The posterior part of each hook is considerably thicker than the anterior part and is somewhat irregular in shape. Each hook has a deep base by which it articulates against the distal end of the hypostomal sclerite. The light spots regarded as sense organs on the internal side of each mouth hook and which are present in the larva of *Musca* are absent here. The ectostomal or dentate sclerites are relatively small and each lies on the ventral and lateral side of each hook. It begins dorsal and curves on the sides and becomes ventral. The accessory sclerites which are situated ventral to and near the posterior portions of the mouth hooks are short and thick and bifurked distally. The unpaired median sclerite (prestomal sclerite) present in *Musca* larva is absent here. Behind the mouth hooks is the hypostomal sclerite of which the lateral portions are very thick and with simple edges.

Anterior to the transverse chitinous bar of the hypostomal sclerite is the epistomal sclerite which is well developed and seems to be divided longitudinally into two chitinous semi-circular plates each of which is provided with a large light spot or perforation near the median line. This sclerite is devoid of the two pairs of sense organs present in the larva of *Musca*. The pharyngeal sclerites are for the most part strongly chitinised and each is produced antero-ventrally where it articulates with a kind of ball and socket joint against the hypostomal sclerite. A strong slender chitinous process projects from this end above the hypostomal sclerite. The pharyngeal sclerite is deeply incised posteriorly and less so anteriorly. The dorsal cornua are also deeply incised and much longer than the ventral cornua which are not produced into a hump. The dorsal arch or dorso-pharyngeal sclerite is now well developed and sharply pointed at both ends, and is not perforated. Ventrally the pharyngeal sclerites are continuous with the floor of the pharynx, and just below the posterior end of the ventral cornua are the pharyngeal sense organs.

7. Puparium

The puparium (Plate III, fig. 25) is nearly cylindrical in shape with a tapering hind end and nearly rounded anterior end. Its length varies from 10 to 15 mm., but the average length is usually 13 mm. It is nearly twice as long as broad. The colour of the pupal case immediately after pupation is pale yellowish, then changes to bright orange and gradually darkens until it finally becomes dark reddish-brown or nearly blackish in colour. The anterior spiracles of the larva appear as minute processes situated anteriorly. The posterior spiracles form two flat button-like structures situated at the bottom of a deep groove corresponding to that of the larva in the last body segment. The small fleshy processes of this segment in the larva are very small and contracted. The borders between the segments appear as continuous lines which are more distinct in the middle region of the puparium. Along these lines there are broad transverse bands of minute black spines. Each band lies in an inter-segmental position and appear to be composed of an upper, middle and lower narrower bands. Other than these bands numerous transverse wrinklings are found on the surface.

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Explanation of Plate I

Fig. 1. — Head capsule of male (front view) : a. = antenna ; cl. = clypeus ; e. = compound eye ; ep. = epistome ; f.p. = position of frontal pit ; fr.s. = frontal suture ; f.s. = frontal stripe ; g. = gena ; g.l. = jowl or lower portion of gena ; o.t. = ocellar triangle ; 1 = vertical bristles ; 2 = post-vertical bristles ; 3 = ocellar bristles ; 4 = frontal bristles ; 5 = fronto-orbital bristles ; 6 = post-orbital bristles ; 7 = vibrissae ; 8 = facial bristles. — × 12.5.

Fig. 2. — Left antenna : ar. = arista (4th, 5th and 6th antennal segments) ; p. = peg of second segment ; s. = socket of third segment ; sn. = sensoria ; 1, 2, 3 = first, second and third antennal segments. — × 50.

Fig. 3. — Proboscis (lateral view) : cl. = clypeus ; ep. = epipharynx ; f. = furca ; fu. = fulcrum ; hp. = hypopharynx ; hst. = haustellum ; lb.ep. = labrum-epipharynx ; lbm. = labellum ; mt. = mentum ; mx.p. = maxillary palp ; pdt. = pseudo-trachea ; ph. = pharynx ; prp. = prepharynx ; psm.sc. = prestomal sclerite ; r. = chitinous rod or the so-called stipes ; rs. = rostrum. — × 18.75.

Fig. 4. — Proboscis (front view) : cl. = clypeus ; fu. = fulcrum ; hst. = haustellum ; lb.ep. = labrum-epipharynx ; lbm. = labellum ; mt. = mentum ; mx.p. = maxillary palp ; pdt. = pseudo-trachea ; prp. = prepharynx ; psm. = prestomum ; psm.sc. = prestomal sclerite ; r. = chitinous rod or the so-called stipes ; rs. = rostrum. — × 18 75.

Fig. 5. — Proboscis (anterior view of labella) : c.ch. = collecting channel ; pdt. = pseudo-trachea ; psm. = prestomum ; psm.sc. = prestomal sclerite. — × 25.

Fig. 6. — 5 prestomal teeth of the proboscis : psm. = prestomum ; psm.sc. = prestomal sclerite. — × 55.

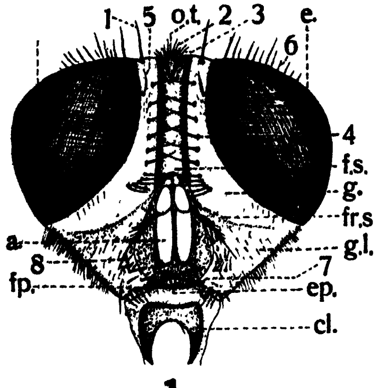
Fig. 7.— Surface view of a pseudo-trachea to show the structure and arrangement of chitinous rings : intb.g. = inter-bifid groove. — × 450.

Fig. 8. — A pseudo-tracheal ring to show its simple and bifid ends (very much enlarged).

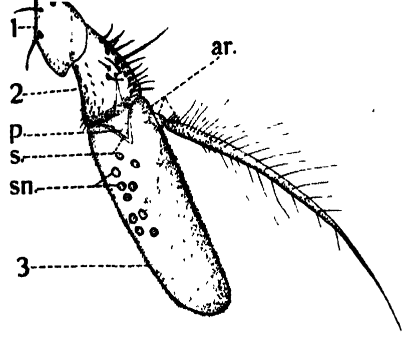
Fig. 9. — Transverse section in haustellum : ep. = epipharynx ; f.ch. = food channel ; hp. = hypopharynx ; lb. = labrum ; mt. = mentum (theca). — × 125.

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Plate I



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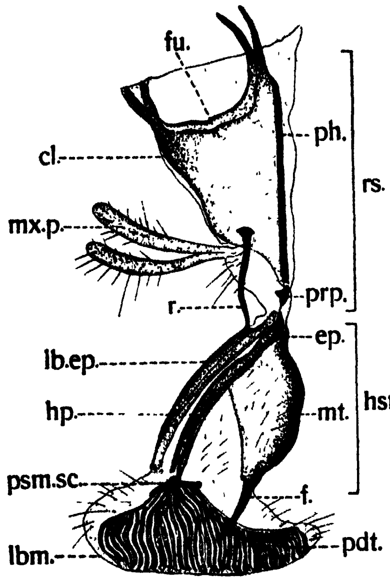
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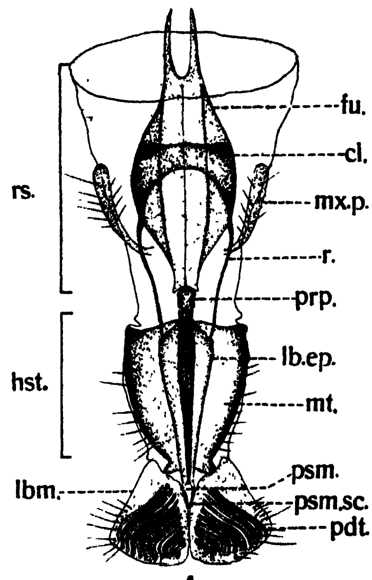
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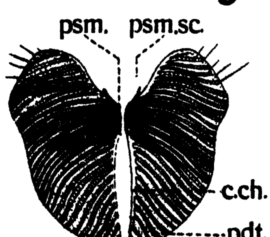
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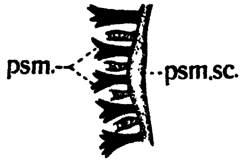
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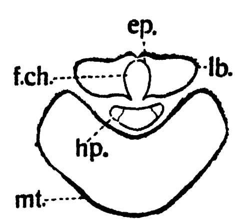
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Morphology and life history
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Explanation of Plate II

Fig. 10. — Right wing: hm. = humeral cross-vein; im. = intermedial cross-vein; rm. = radio-medial cross-vein; tg. = tegula; C. = costa; M. = media; R. = radius; Sc. = sub-costa. — For other letterings see text. — × 7.5.

Fig. 11. — Fore, mid and hind legs of male: cx. = coxa; f. = foot; fm. = femur; tb. = tibia; tr. = trochanter; ts. = tarsus. — × 7.5.

Fig. 12. — Ventral view of foot: cl. = claw; epd. = empodium; l.f.p. = lateral foot plate; m.f.p. = median foot plate; pv. = pulvillus; ts.5. = fifth or last tarsal segment. — × 107.5.

Fig. 13. — Ventral view of female terminalia: a.c. = anal cerci; sp. = spermatheca; st.5 = sternum 5; st.6 = sternum 6; st.7 = sternum 7; st.9 = sternum 9; st.10 = sternum 10; tg.6 tergum 6; tg.7 = tergum 7. — × 22.5.

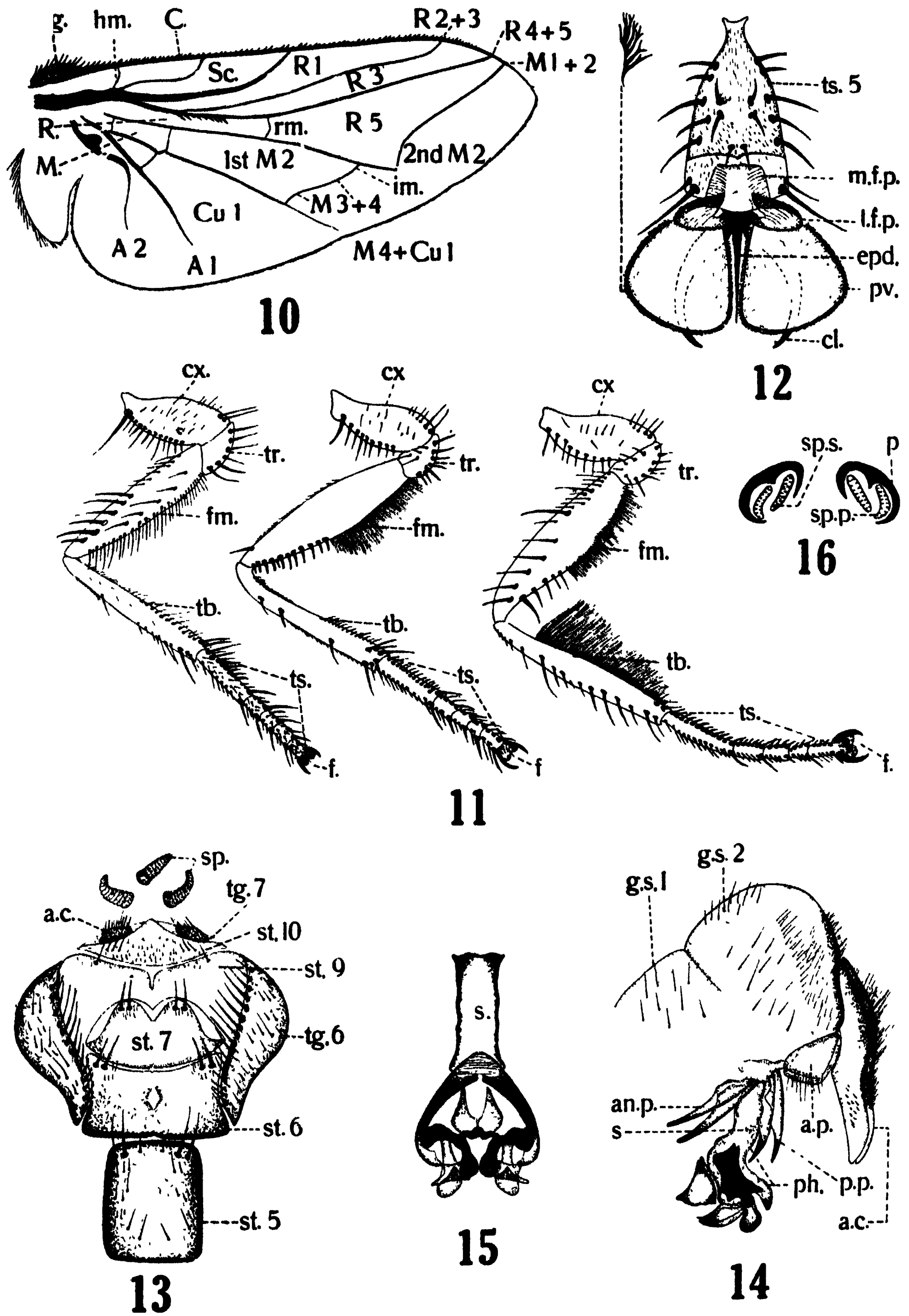
Fig. 14. — Lateral view of male terminalia: a.c. = anal cerci; a.p. = accessory plate; an.p. = anterior paramere; g.s.1 = first genital segment (7th tergo-sternum); g.s.2 = second genital segment (9th tergo-sternum); ph. = phallosome; p.p. = posterior paramere; s. = shaft of phallosome. — × 23.75.

Fig. 15. — Front view of phallosome: s. = shaft. — × 37.5.

Fig. 16. — Posterior spiracle of the second stage larva: p. = peritreme; sp.p. = spiracular plate; sp.s. = spiracular slit. — × 87.5.

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Plate II



Morphology and life history
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Explanation of Plate III

Fig. 17. — Ventral view of the head of the third stage larva : c.l. = cephalic lobes ; f.c. = food channels ; m.h. = mouth hook ; mx.p. = maxillary palp ; pr. = prothorax. — × 42.5.

Fig. 18. — Dorsal view of the head of the third stage larva : a. = antenna ; c.l. = cephalic lobes ; mx.p. = maxillary palp ; pr. = prothorax. — × 45.

Fig. 19. — Dorsal view of a spinose ring between the fifth (5) and sixth (6) body segments. — × 13.75.

Fig. 20. — Posterior view of the last abdominal segment of the third stage larva : p. = pit in which the posterior spiracles are situated. — × 11.25.

Fig. 21. — Anterior spiracle of the third stage larva. — × 112.5.

Fig. 22. — Posterior spiracle of the third stage larva : p. = peritreme ; sp.p. = spiracular plate ; sp.s. = spiracular slit. — × 62.5.

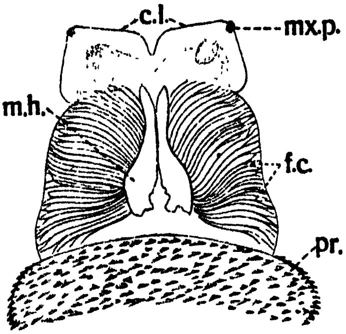
Fig. 23. — Lateral view of the cephalo-pharyngeal skeleton of the third stage larva : ac.s. = accessory sclerite ; d.a. = dorsal arch (dorso-pharyngeal sclerite) ; ec. = ectostomal sclerite ; hy. = hypostomal sclerite ; ph. = pharyngeal sclerite ; ph.s. = pharyngeal sense organ ; r.m.h. = right mouth hook. — × 45.

Fig. 24. — Dorsal view of the anterior part of the cephalo-pharyngeal skeleton of the third stage larva : ac.s = accessory sclerite ; ec. = ectostomal sclerite ; ep. = epistomal sclerite ; hy. = hypostomal sclerite ; l.m.h. = left mouth hook ; r.m.h. = right mouth hook — × 47.5.

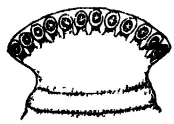
Fig. 25. — Puparium. — × 3.75.

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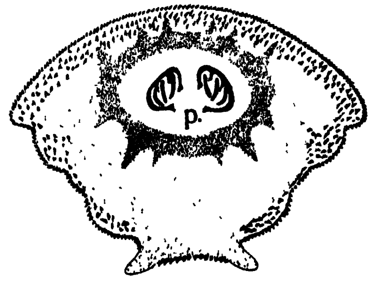
Plate III



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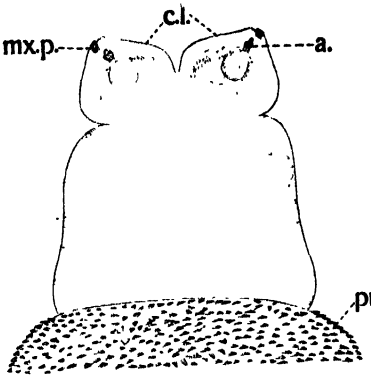
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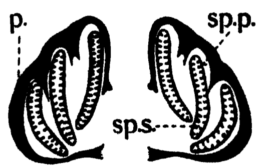
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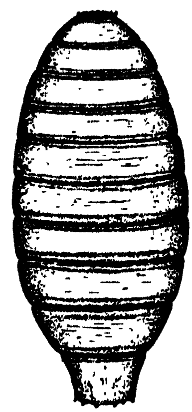
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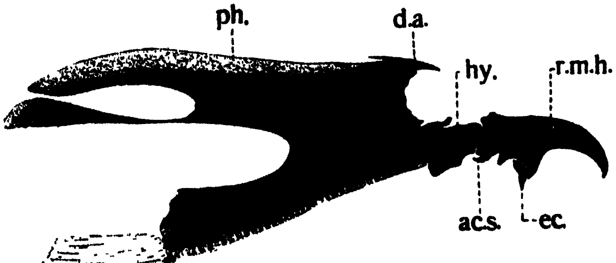
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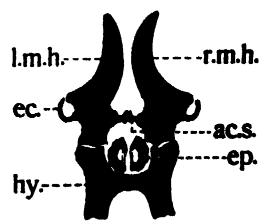
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Morphology and life history
of *Sarcophaga falculata* Pandellé

Studies in the biology of *Microbracon hebetor* Say

[Hymenoptera : Braconidae]

(with Tables I-XVI and 2 Illustrations)

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CONTENTS

I. ACKNOWLEDGMENT

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II. TECHNIQUE

Rearing the parasitoid *Microbracon hebetor* Say proved to be easy compared with rearing its hosts *Ephestia*, *Plodia* and *Galleria* on which the parasitoid was kept. This was largely due to the fact that *Ephestia, Plodia* and *Galleria* larvae exude a certain amount of humidity from their bodies, and when numerous larvae were kept together, the water-content of the culture rose considerably with the result that moulds developed and the culture was spoilt. This difficulty was got over by keeping the hosts in small numbers, in vials (5½ high and 3 inches in diameter) and by covering these vials with muslin to allow evaporation.

In case of *Ephestia* two mated females were placed in each vial with about 100 grammes of Quaker oats. In *Plodia* culture the food used was 40 grammes of sultanas to each vial containing three mated females. In *Galleria* culture the food was comb wax and the number of mated females to each vial was two. It was found necessary in case of *Ephestia* and *Plodia* to keep the vials in incubators at 24 ± 1° C. *Galleria* culture went well at room temperature.

Rolls of corrugated paper were placed in all vials. When the larvae were fully fed, they readily crawled into those rolls and, thus, larvae and pupae could be used as they were required. This method facilitated handling the hosts and kept the culture in good condition.

III. HISTORICAL

The species was first described in America by Say (1836) under the name *Bracon hebetor*. In Belgium, Wesmeal (1838) described another very similar on the following characters :

1. Female's antenna of 13-15 segments, abdominal dorsum smooth (hosts are caterpillars feeding on stored products, i.e. *Ephestia, Plodia, Galleria*, etc.) .... *Bracon hebetor* Say
2. Female's antenna of 16-17 segments, abdominal dorsum rough and punctated (hosts not caterpillars of stored products, mostly *Pyrausta nubilalis* Hub. and *Dioryctria abietella* Zinck. .... *Bracon brevicornis* Wesm.

These diagnostic characters were not noticed by entomologists before 1922, with the result that a great deal of confusion occurs in literature referring to the species. Kirby (1884) exhibited at a meeting of the Entomological Society of London a parasite of *Ephestia* from a London wharf and identified it as *Bracon brevicornis* Wesmeal (1). Marshall (1885) appa-

(1) Brischke description (1882) is apparently the true *Bracon brevicornis* and hence not referred to here.

rently did not see Say's description; he describes the species under *Bracon brevicornis* Wesm.; he gives a figure of the fore wing and another of the female's head and thorax. Klein (1887) read a paper entitled "Appearance in London of *Ephestia kühniella* and the remedy provided by Nature" at a meeting of the Middlesex Natural History Society. He refers to the species as an "Ichneumonid" and gives sketches of the male and female, but the two sketches are, indeed, very far from being helpful [2]. Billups (1888) bred the species from *Ephestia kühniella* Z. and recorded it as *Bracon brevicornis* Wesm. Ashmead (1888) describes it as a new species, *Bracon juglandis*, mainly because the one male specimen from which he made his description was black and did not agree with Say's details of colouration; the host he mentions is a "Lepidopterous larva infesting old walnut". Von Danysz (1893) mentions that the species is of good economic value against *Ephestia* in mills in France. Johnson (1895) reared it from *Ephestia* and was the first to change the generic name to *Habrobracon*, a step which was afterwards extended to the whole genus by Ashmead (1900). In this and in another paper (1895) Johnson refers to the species as *Habrobracon hebetor* Say. Riley and Howard (1895) report it on *Plodia interpunctella* Hb.. Schmiedeknecht (1896) does not differentiate between the 2 species and mentions that the female antenna varies from 14 to 17 segments, his description comes under *Bracon brevicornis* Wesm. Chittenden (1897) refers to the species as *Bracon (Habrobracon) hebetor* Say; he gives the first instructive figure for the female and reports it as a parasite of *Galleria mellonella* L. in bee hives, as well as of *Ephestia* in warehouses in America. He points out the difference in the number of antennal segments between *Bracon brevicornis* Wesm. and *Bracon hebetor* Say, but thinks that it is not improbable that they are one and the same species. Johnson (1899) records it from *Ephestia*. Szépligeti (1906) describes the species as *Habrobracon brevicornis* Wesm. Buchwald and Berliner (1910) refer to the species as *Habrobracon hebetor* Say, but they erroneously figure the female with a 21-segmented antenna, however, in their short paper, they discuss the economic value of the insect as a parasite against *Ephestia kühniella* Z. in mills of Germany; and they conclude that the wasp is useful though it cannot completely destroy the pest. Popenoe (1911) mentions the species as *Hadrobracon hebetor* Ashm. parasite on *Plodia interpunctella* Hb.. Doten (1911), under *Microbracon juglandis* Ashm., describes some biology of the species and gives good photographs of the female stinging the host, and feeding at punctures. Froggatt (1912) under *Bracon (Hadrobracon) hebetor* Say records the species from *Ephestia kühniella* Z. and gives a brief systematic description with a

(2) It is erroneously stated in many papers that Kiekie and not Klein read this paper.

figure of the female. Viereck (1911) describes the insect as a new species (*Habrobracon beneficentior*) and mentions that its affinities are with *Habrobracon brevicornis* Wesm.; he reports it from maize store houses in America, Mozambique and Portuguese East Africa. Berliner (1911) worked out some points in the life history and discovered parthenogenesis in the species. Durrant and Beveridge (1913) reported the species from *Ephestia kühniella* Z. in army biscuits and refer to it as *Bracon brevicornis* Wesm.. Cushman (1914) suggests that *Habrobracon hebetor* Say of all authors must sink in synonomy with *Habrobracon brevicornis* Wesm., while *Habrobracon hebetor* of Say must stand as an unknown species. Parker (1915) writes that *Plodia interpunctella* Hb. in California is frequently attacked by *Habrobracon hebetor* Say, but the infestation is not appreciably affected by the ravages of the wasp. Swezey (1915) describes its occurrence on *Plodia* and *Ephestia* from warehouses in Honolulu and gives the duration of the life cycle. He thinks that the shortness of the life-cycle renders the insect very effective in controlling the flour moth. Roubaud (1917) reports its parasitism on *Ephestia cautella* Walk., in ground nuts in Senegal. Whiting (1918) showed that colour in this species does not yield to selection and suggests that difference in colouration is probably due to some environmental influence; he also describes parthenogenesis. Burkhardt (1919) drew up a list of the natural enemies of *Ephestia kühniella* Z. and mentions both *Habrobracon hebetor* Say and *Bracon brevicornis* Wesm. amongst them. Whiting (1921) studied heredity in the insect, and found that temperature was the factor affecting colour. The same author (1921) describes the way of breeding the insect for genetic work. Still the same author (1922) shortly describes some genetic mosaics and ontogenetic abnormalities in the adult. In all his works Whiting erroneously refers to the species as *Hadrobracon brevicornis* Wesm.. Back (1920) writes that *Habrobracon hebetor* Say exercises a check on the number of *Ephestia kühniella* Z in flour mills in America and considers it to be only an accessory factor in the control. Waterston (1921) reports it from grain pests. Rao (1922) mentions the species under *Habrobracon kitcheneri* Dudg. and Gough parasitising *Batrachedra amydraula* Meyr. a pest of dates and *Earias insulana* Boisd. in Iraq. Hase's work (1922) stands out as the first serious contribution to the study of the biology of the species, with special reference to biological control. If we exclude Berliner's and Whiting's, all the works before Hase's are either short descriptive notes of pure taxonomic value, or of superficial nature merely reporting the occurrence of the insect. Hase describes the possibilities of breeding the insect on a large scale the whole year round. He concludes that the economic value of the wasp against *Ephestia* in mills is considerable, but that it cannot be recommended as the only means of control, and that if it is properly bred and liberated it can prove a useful auxiliary in retarding the increase

of the meal moth. In this work Hase refers to the insect as *Habrobracon brevicornis* Wesm.. Cushman (1922) cleared up the confusion regarding the identity of *Habrobracon brevicornis* Wesm. and *Habrobracon hebetor* Say. Hase (1923) showed the importance of olfactory sense to *Microbracon* in choosing its host. De Ong (1923) refers to the species as *Habrobracon juglandis* Ashmead and gives the developmental period of its different stages on *Plodia* larvae at room temperature of 24-30° C. He writes that the parasite is the most abundant and widely distributed of any attacking *Plodia* in California. He succeeded in breeding the insect on *Aplomia gularis* Zeller, a caterpillar which infests peanuts. Schulze (1924) describes the way in which the insect cleans its body and appendages. The same author (1924) describes the way in which the antennae are held in receiving different stimuli. He showed that the antennae of the male, besides being olfactory and tactile, are used as mechanical support to the body. Hase ((1924) describes some experiments on the biology of the male and concludes that for breeding purposes only young males should be used to fertilise the females. He refers to the species as *Habrobracon juglandis* Ashmead a specific name which is still used by all German authors. Musebeck (1925) discusses the synonymy of the species and concludes that references in literature to *Bracon* or *Habrobracon brevicornis* Wesm., *hebetor* Say or *juglandis* Ashm. as parasites of *Ephestia kühniella* Z.. *Plodia interpunctella* Hb. or *Galleria mellonella* L. concern this species i.e. *Microbracon hebetor* Say [3]. Whiting (1925) found that abnormal males have a high percentage of sterility and their few daughters are almost completely sterile. The cause of this sterility has not been discovered, but she suggests a defect in the oogenesis or spermatogenesis as being responsible. Zacher (1926) reports the species as a parasite on *Ephestia elutella* Hb. in raw cocoa, chocolate and similar products. Schlottke (1926) under *Habrobracon juglandis* Ashm., investigated the influence of temperature on size and pigmentation. He found that the formation of pigment decreases with the increase of temperature, and that pigment is deposited particularly at muscle origins and insertions. Kühn (1927) investigated the predetermination of pigmentation and its inheritance through genes and plasma.

Johnston (1927) writes that *Microbracon hebetor* Say is sometimes an important parasite of the moth *Corcyra cephalonica* Stt. which is a pest of stored seeds. Fahringer does not clearly differentiate between *Habrobracon brevicornis* Wesm. and *Habrobracon juglandis* Ashm.. Myers (1928) reports it as the most important natural enemy of *Plodia interpunctellla* Hb.. In Australia, Schwell (1928) studied some points in the bionomics

(3) Viereck (1917) is responsible for changing the generic name into *Microbracon.*

of the species in Australia with special reference to biological control of *Plodia*. Henschen (1928) describes the development of sex glands and the effect of hunger on egg production, he finds that the number of mature eggs in overules are less in females which were kept hungry for 3 days than in normal females. Myers (1929) describes some of the species' habits. Munro and Thomson (1929) write that *Microbracon hebetor* Say undoubtedly plays a large part in reducing the number of *Ephestia* larvae which are able to complete their life-cycle in warehouses in London, and that the possibility of its use as a biological control against *Ephestia* in warehouses is an unexplored field. Hagan (1929) describes the insect's effectiveness against *Plodia interpunctella* Hb. in fig plantations of Smyrna. Durham (1929) writes that it causes rapid reduction in the number of meal moths breeding in extracted combs of bee hives. Richard and Herford (1930) enumerate the products in which the species is found in London warehouses. Knowlton (1931) in three cases out of eighteen attempts succeeded in breeding the species on the codling moth larva *Carpocapsa pomonella* Lin., and, in one instance, on an "unidentified hymenopterous larva removed from willow twig galls." He gives some short notes of biological interest of the species in Utah, America. Payne (1931) shows the effect of temperature upon the development and length of life of the insect. She refers to the species as *Habrobracon juglandis* Ashmead. Goidanich (1931) mentions the specific characters differentiating *Microbracon hebetor* Say from *Microbracon brevicornis* Wesm. Richards and Thomson (1932) review the nomenclature and synonomy of the species and outline the life-history and distribution.

IV. HABITAT

Microbracon hebetor Say is a member of the stored products [4] fauna. It is always found associated with its Pyralid hosts *Ephestia*, *Plodia*. and *Galleria*, harboured in mills, warehouses, wharves, docks, seed stores and ship stores. In these places comparatively dry plant and animal products such as flour, meals, cereals, seeds, dried fruits and bees' wax are stored in large quantities which serve as an inducing trophic factor in attracting a special biotic complex. The temperature met with in such places sometimes allows many insects to breed almost continuously throughout the year. Although this definite and highly specialised habitat with its dry conditions and indoor light and temperature is generally the typical habitat of the species, there is on record, Muesebeck (1925), an instance where it has been collected

[4] For the definition of "Stored Products" see O. W. Richards (1932) on "Insect attacking stored Products", *Science Progress*, No. 103, 475 pp.

from cone-galls of *Salix longifolia*, and from bee hives, Chittenden (1897).

V. FOOD

The species is ectophagous on the late larval instar of the host. Both experiments and field observations showed that the larva is the only stage attacked by the parasite. Imms (1931, p. 274) pointed out that ectoparasites very rarely affect hosts living openly and exposed. Salt (1931) states that the genus *Microbracon* prefers hosts from which it is separated by an inert covering. *Microbracon hebetor* Say is apparently one of the rare instances which, although ectophagic, attacks exposed hosts. In wharves and warehouses the walls and ceilings can be seen covered with exposed hosts which have been attacked by *Microbracon* ([5]). In the laboratory the writer introduced the female *Microbracon* in petri-dishes containing *Ephestia* larvae (always more than 30 in number) some of which were naked and some in their cocoons, in all cases the naked hosts were attacked first; in some rare cases those in the cocoons were not attacked. This shows that *Microbracon hebetor* Say prefers exposed hosts to concealed ones.

Food of larva

The larva of *Microbracon hebetor* Say feeds on the fluids, semi-fluids and, to a limited extent, small pieces of the host which the mother stings and consequently paralyses before laying her eggs. In some cases decay of the host sets in before the parasitic larvae pass their feeding period. the parasites then continue their feeding and in most cases complete their life-cycle; Berliner (1911) and Hase (1922) made the same observation. If the decay is very advanced, the parasites fail to complete their transformation. Whether the failure in this case is the result of a pathological effect or is due to deficiency in the composition of the decayed diet, or to both, the writer is not in a position to say. Sometimes the host is attacked by the ascomycetes fungus *Cordyceps militaris*, and even when the attack is very severe, the *Microbracon* larvae continue their feeding and successfully complete their development.

Food of adult female

The adult female, after piercing the host with her stinging apparatus

([5]) It is interesting to note that when the host is stung by *Microbracon* the host applies its crochets to the webbed strata and thus is paralysed and at the same time fixed in its position; this fact explains how hosts cling to walls and ceilings and do not fall after their paralysis.

and thus paralysing it feeds at the punctures on the fluids that come out. The sting only paralyses the host and does not kill it as thought by Munro and Thomson (1929). In one instance the writer kept a paralysed *Plodia* host, at winter room temperature (14° to 17° C.), 65 days before the heart stopped beating. Myers (1929) writes that "in an extreme case the heart of a *Plodia* larva may continue to beat for 23 days"; Hase (1922) records 50 days between parasitism and death for *Ephestia kühniella* Z.. If given a host which has already been stung by another female, the adult female feeds on it; a dead host is also accepted, and usually eggs are laid on such hosts if they are fresh, and not decaying or attacked by bacterial diseases; if they are, the female feeds on them without being affected, but she never lays any eggs on such hosts.

Food of adult male

The food of the adult male is difficult to ascertain. Contrary to Hase's statement, it does not feed on the host, because, having no sting it cannot paralyse a host for itself and, as a series of experiments conducted by the writer showed, it does not feed on hosts paralysed by females.

When given cut pieces of sultanas the males feed on them, also they feed on sugar solution and drops of honey. It appears then that males in places like warehouses and wharves, live on what they can get out of dried fruit, but in places like mills where flour and meal is dry they lead aphitic life.

In the absence of a host, the female's fate in feeding will be exactly that of the male, and in this case of course she cannot lay any eggs. Both sexes can live a long time without any food or water — the male can live from 8 to 16 days, the female from 10 to 25 days.

The interesting point here is that the larval stage takes nitrogenous food during the whole period of its life; the adult female takes nitrogenous food during at least a period of its life, while the adult male does not take any nitrogenous food. This nitrogenous food is derived from the host larva. There is an intimate correlation between the function of the different stages and the food taken by them. The larva is the growing stage of the species, for this reason it needs nitrogenous nutriment during the whole period of its life, the female is the stage in which eggs develop, during the period of development of eggs, the female needs nitrogenous food. In case of the adult male, there is neither growth nor egg development and hence it does not need any nitrogenous nutriment during the whole period of its life.

In the laboratory the writer gave the adults sultanas, currants, bananas, honey and sugar solution and both males and females accepted and lived on these diets Hase (1922) tried with success marmalade, sweet paste and even chopped meat.

The writer's cultures were bred mainly on *Ephestia kühniella* Z. and *Plodia interpunctella* Hb.

VI. HATCHING

When the embryo is ready to issue from the egg, it can be seen through the transparent chorion lying straight and surrounded by the amniotic fluid. The gut is full of yellow small globules of fat and granular material which are presumably remnants of the yolk. The urate cells can faintly be seen.

The pharynx and œsophagus have well developed muscles by means of which they start a pumping process in the head, which is followed by a peristaltic movement of the gut, and a contraction and expansion movement of the abdomen. The combined action of these processes drives the body fluid powerfully into the head, the fluid, then, returns gently backwards to be again powerfully driven into the head, and the movement continues until hatching, and even for some time afterwards.

The mandibles unceasingly move in jerks backwards and forwards. The embryo swallows the amniotic fluid, and shortly afterwards, it swallows bubbles of air. The intake of fluid and air is effected by the pharyngeo-oeosphageal pumping action. Every time an air bubble is swallowed, there is a corresponding slight depression of the area of the chorion opposite the mouth; this proves that the air swallowed is an outside air. Nuttall (1918) experimentally proved the same phenomenon in *Pediculus humanus* L.. Sikes and Wigglesworth (1931) showed that many insect in the eggs take outside air in the trachea. Thus Heymone's generalisation (1926) that an insect in the egg is never known to take up outside air, either through the mouth or into the trachea, is completely refuted. As a consequence of growth and intake of amniotic fluid and air, the embryo enlarges in size and now fills the whole shell.

The urate cells now show very clearly. The trachea begin to appear, at first full of fluid afterwards of gas; gas appears first in the tracheal trunks and afterwards in the capillaries. Frankenberg (1915) put forward the suggestion that the embryo in the egg is under hydrostatic pressure, and that when this hydrostatic pressure is reduced by hatching, the liquid in the trachea is absorbed by osmosis and secreted gas appears in the trachea. On the other hand Keilin (1924) advances the theory that the tracheal fluid is absorbed by the cells of various tissues from the intra-cellular capillary tracheoles; the column of fluid is thus ruptured, the space left by the retiring fluid being immediately filled by gases diffusing from the surrounding media (blood). Sikes and Wigglesworth (1931) working on different examples, none of which a hymenopterous one, disproved Frankenberg's suggestion. In *Microbracon hebetor* Say the appearance of gas in the whole respiratory system takes place quite a long time before hatching. This shows

that the idea of hydrostatic pressure on the embryo is untenable, confirms Sikes and Wigglesworth's work and extends it to Hymenoptera. Thus the balance of evidence favours Keilin's theory.

The embryo now becomes more active and pushes itself against the walls of the anterior pole of the egg leaving at the posterior end an empty portion which soon collapses. Nuttall (1918) working on *Pediculus humanus* L. attributes the forward pushing of the embryo to the action of air expelled from the anus and accumulating behind the embryo. This phenomenon does not, and cannot, happen in the case of *Microbracon*, because the hind gut at this stage is not connected to the rest of the gut. The forward movement of the embryo here is entirely due to muscular action.

The anterior pole of the egg now enlarges in size due to the sudden enlargement of the head and prothorax of the embryo. The antennae can be seen pushing against the chorion and finally pushed through it and slitting it open. In many cases the antennae re-enter the cut and again are pushed against the chorion at another place and a new slit is made; sometimes the chorion is slit in many places before the larva pushes out its head. It then wriggles out of the chorion leaving behind the embryonic envelopes, and thus hatching is complete. The whole process from the time the embryo starts moving its head until the larva frees itself from the shell takes an average of two and a half to three hours at summer room temperature of 20-22° C. Gas appears in the trachea half an hour before hatching, under the same conditions.

Hase (1922) did not recognize the phenomenon of swallowing amniotic fluid and air. He states that the egg shell is sucked in from the inside with the object of slitting it by means of the needle-shaped mandibles. The present writer cannot confirm this statement. In no case were the mandibles seen slitting the chorion in this insect. In every case the antennae were the organs responsible for piercing the chorion, and, as arleady mentioned, the insucking of the chorion opposite the mouth is correlated with swallowing of air bubbles. The incessant movement of the mandible is probably to help swallowing. In *Microbracon brevicornis* Wesm. though Genieys (1925) does not mention which organ actually slits the chorion, it is clear from his description that the mandibles take no part in the process; he describes the antennae as being the first organs to appear out of the shell though he did not observe that they pierce the chorion.

VII. DURATION OF LIFE IN IMAGO

The duration of *Microbracon hebetor* Say imago has been differently estimated by different authors as shown in Table I.

Unfortunately the conditions under which each worker obtained his results are not described. This inadvertency not only exaggerated the dif-

ference between the results of the authors, but deprived their data of its valuable significance.

TABLE I

Estimation of duration of *Microbracon hebetor* Say imago according to authors

AUTHOR	LONGEVITY OF MALES IN DAYS	LONGEVITY OF FEMALES IN DAYS	CONDITIONS MENTIONED
Berliner (1911) ..	9 (maximum)	30 to 40	—
Doten (1911).....	7	—	70 to 80° F.
Whiting (1918)...	—	42	—
Hase (1922)	24	78	Fully nourished? Room temperature?
	21	27	Starved? Room temperature?
Schwell (1928)....	—	42	—
Knowlton (1931)..	1 to 18 (average 7.2)	1 to 37 (average 15.2)	—
Payne (1931).. ..	90 and 3		Under 3 and 36° C. consecutive. Sexes not mentioned.

TABLE II

Longevity of females of *Microbracon hebetor* Say emerging during August-September

LONGEVITY IN DAYS	51 to 60	61 to 70	71 to 80	81 to 90
Frequency	5	18	20	10
Room temperature range 13 to 21° C.				Total 53

TABLE III

Longevity of females of *Microbracon hebetor* Say emerging during October-November and passing through Quiescent Period

LONGEVITY IN DAYS	91 to 100	101 to 110	111 to 120	121 to 130	131 to 140	141 to 150	151 to 160	161 to 170	171 to 180	181 to 190	191 to 195
Frequency	4	4	5	6	4	7	10	4	4	3	3
Room temperature range 10 to 18° C.											Total 54

TABLE IV

Longevity of females of *Microbracon hebetor* Say
emerging during May-July

LONGEVITY IN DAYS	21 to 30	31 to 40	41 to 50	51 to 60	61 to 70
Frequency	2	6	16	21	9
Room temperature range 14 to 31° C.					Total 54

Duration of life in female

Tables II, III and IV show in details the duration of life obtained by the writer for the female in different periods of the year, the average of duration is given in Table V. These females were bred on *Ephestia kühniella* Z. larvae at ordinary room temprature (shown under each Table and taken

TABLE V

Average longevity of females of *Microbracon hebetor* Say
in different seasons

TIME OF EMERGENCE	AVERAGE OF LONGEVITY IN DAYS
August to September	71.98
October to November and through Quiescent Period	144.24
May to July	51.80

from a daily chart). Some of the females were mated and some were virgins. The writer did not find any difference in duration of life between mated and virgin females.

It will be noticed that the duration of life in females differs in different seasons; in summer when the activities of the insect and its rate of living is at its height females' lives are short; in autumn they are longer. In winter some of the females which passed through the quiescent period lived 195 days or nearly 28 weeks, a fact to which attention is especially called and which entirely changes our outlook on the longevity of the species.

Duration of life in males

At room temperature (17 to 20° C.), starvation, and ordinary day light, males which mated lived 12-14 days; males which did not mate lived 14

TABLE VI

Frequency of longevity in males and females of *Microbracon hebetor* Say, when starved, fed on water, and on sugar solution.

LONGEVITY IN DAYS			14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	TOTAL
Frequency of longevity	Starved	♀♀	—	—	—	—	—	—	—	—	—	—	—	1	2	6	4	5	6	1	25
		♂♂	—	1	2	6	9	5	2	—	—	—	—	—	—	—	—	—	—	—	25
	On water	♀♀	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
		♂♂	—	—	—	—	—	—	—	—	—	3	7	7	8	—	—	—	—	—	25
LONGEVITY IN DAYS			**32**	**33**	**34**	**40**	**41**	**42**	**43**	**44**	**45**	**46**	**47**	**48**	**49**	**50**	**51**	**52**	**53**	**54**	
Frequency of longevity	On water	♀♀	—	—	—	—	—	—	—	2	4	4	8	5	2	—	—	—	—	—	25
		♂♂	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	On sugar solution	♀♀	—	—	—	—	—	—	—	—	—	—	—	—	4	8	8	3	2	—	25
		♂♂	—	—	—	—	—	—	—	—	4	5	7	6	3	—	—	—	—	—	25

In dark, and room temperature range 15 to 17° C. Total 150

to 16 days; under constant temperature of 26 ± 0.5° C. starvation and ordinary daylight males which mated lived an average of 8 days, males which did not mate lived 10 days. Number of individuals used in experiment was 50 mated and 50 did not mate in the first case, i.e. room temperature, and 25 mated and 25 did not mate in the constant temperature of 26 ± 0.5° C. and all the males came from a batch bred at room temperature.

Effect of starvation and nourishment on longevity

Duration of life of both sexes differed when the insect was : (1) starved, (2) given tap water, (3) given cane-sugar solution (5 gr. in 100 cc.). The frequency Table VI shows the details of longevity with every treatment, which is summed up in Table VII.

TABLE VII

Average of longevity of *Microbracon hebetor* Say with different treatment

TREATMENT	LONGEVITY IN DAYS	
	♀♀	♂♂
Starved	28.28	17.48
Given water	46.64	24.81
Given 5 % Cane sugar solution	50 64	42 96

It will be noticed that there is a difference in the duration of life between the starved males in this experiment and those in the last one; this is due to the fact that this experiment was carried out in the dark, and at a room temperature of 15-17° C., which is lower than that of the last experiment, both these two factors dark and low temperature, tend to lessen the activities of the insect, and, as shown by Wheeler (1928), Alpatov and Pearl (1929) and Imms (1932), the total duration of life varies inversely as the rate of energy-expenditure.

VIII. PARTHENOGENESIS

The phenomenon of parthenogenesis is of constant occurrence in this species, and fertilisation is neither an absolute condition nor a stimulus for oviposition or development of eggs.

Fertilised females produce males as well as females, while virgin females produce males only; this arrhenotokous type of parthenogenesis is the rule in this insect but Hase (1922), in one instance, got males and females from a virgin female. The present writer also got this deuterotokous partheno-

genesis happening only in one case, and was unsuccessful in his repeated experiments to get it to happen again [6]. There is no question of doubt about the virginity of the female which gave this instance of deuterotoky, the writer got all his virgin females from individuals isolated in the larval stage just when these started spinning their cocoons. Whiting at first did not find this deuterotokous parthenogenesis in this species; in 1918 he wrote "Not a single female has been produced from a virgin female"; again in 1921 he wrote "Parthenogenesis is strictly haploid, thousands of offsprings reared from virgin females include not a single female". But Wheeler (1928, p. 163) wrote that Whiting informed him that he (Whiting) secured few females from unfertilized eggs. There is a similar case recorded in the Tenthredinid *Nematus miliaris* Panz., which is normally arrhenotokous, but in one occasion Fletcher (1880) bred 22 males and one female from a virgin. It is difficult to understand the significance of these isolated instances; in the case of *Microbracon hebetor* Say, probably we are dealing with a species in which a new genetic race is evolving and, at the end, will be established; a case parallel to what we get in the Chalcid *Trichogramma pretiosa* Ril. and the Aleurodid bug *Aleurodes vaporariorum* Westwood, where a thelyotokous race and an arrhenotokous one, are met with (Williams, 1917). In the case of *Microbracon hebetor* Say one race will be arrhenotokous, the other deuterotokous in their parthenogenesis.

It is noteworthy that all types of parthenogenesis occur in the family Braconidae. *Microbracon brevicornis* Wesm. (Genieys, 1925) and *Microbracon hebetor* Say are examples of arrhenotoky; thelyotoky is described in *Pygostolus falcatus* Nees by Jackson (1928) and in *Apanteles thomsoni* Lyle by Vance (1931); deuterotoky is described by Hunter (1909) in *Lysiphlebous tritici* Hunter. Furthermore, in the same genus *Dinocampus* (*Perilitus*), one species (*Dinocampus coccinellae* Schrank) is thelyotokous while another (*Dinocampus rutilus* Nees) is arrhenotokous.

IX. LIFE HISTORY

Although *Microbracon hebetor* Say has been the subject of research for many investigators in different countries, no attempt has been made to work out its complete life-history. Munro and Thomson (1929) wrote "Much work is necessary before definite statement can be made upon the life-cycle and many of the habits of *Microbracon* under British climatic conditions."

[6] The conditions under which the writer got his instance of deuterotoky were :

(a) The virgin female in question was bred at room temperature 64-70° F.

(b) The virgin female was given her first host when she was 8 days old and no food or water was given to her before her first host. The eggs she laid developed at room temperature of 64-70° F., on one day during their development, the temperature dropped to 58-60° F. and this was during the early pupal period.

Also as far as the present writer is aware the life-history of no member of the whole genus *Microbracon* is at all known. It was, however, for this reason, and hoping that it might throw some light on the value of the insect in the field of biological control, that the present writer investigated the life-history of the species. For the sake of convenience it is described under the following sub-headings: Life-cycle, Seasonal history, Number of generations, and Quiescent period.

Life-cycle

The succession of stages through which the species passes in order to complete its life-cycle is the adult, the egg, four larval instars, prepupa and pupa. The time taken by each stage to complete its development varies during the different months of the year according to temperature. Observations upon insects kept in a tube in ordinary room temperature and fed upon larvae of *Ephestia kühniella* Z. gave the times for the completion of the life-cycle as shown on Table VIII. The periods were calculated from the time the egg was laid to the emergence of the mature insect.

TABLE VIII

Life cycle during different months

MONTH	LIFE CYCLE IN DAYS	REMARKS
May and first week of June	32	Temperature ranged from 60 to 69° F.
June	18	Temperature mostly above 70 and under 80° F.
July	28	Temperature round 64° F.
August	22	Temperature about 70° F (in pupal stage it was 90° F.).

Under controlled temperature the variation was as recorded on Table IX.

TABLE IX

Life cycle under controlled temperature

TEMPERATURE IN °C.	LIFE CYCLE IN DAYS
22	17 to 18
24	14
25	12
26	10
30	9

The time taken for the completion of the various stages of the life-cycle at room temperature in May and first week in June is shown in Table X. The temperature during that period ranged from 60-69° F.

TABLE X

Developmental period of different stages at room temperature

STAGE	TIME IN DAYS
Egg	3
Larva { feeding	7
Larva { spinning and at rest	8
Prepupa	2
Pupa	12
Total	32

The details of the life-cycle under controlled temperature are recorded on Table XI.

TABLE XI

Developmental period of different stages under controlled temperature

STAGE	TIME IN DAYS AT 22° C.	TIME IN DAYS AT 25° C.
Egg	2	1
Larva { feeding	3	3
Larva { spinning and at rest	3	1
Prepupa	2	1
Pupa	8	6
Total	18	12

The length of the life-cycle is not only affected by temperature, but is prolonged when the host of the parasite is in poor condition, or is in its early instars, that is to say when the food supply is not normal.

Seasonal history

Microbracon hebetor Say passes the winter in hibernation. Breeding usually starts towards the end of January and during February. The first

generation appears sometimes as early as the third week in March and sometimes as late as the last week in May, according to the prevailing temperature and to individual variations. The generation that appears the second week of October does not start breeding then, but enters the quiescent period until the next spring when breeding commences. Males do not survive the winter, females generally do. Towards the two ends of the breeding season (October to March), the life of males and females is usually longer than it is in the middle of the season, and the rate of development in the middle of the breeding season is greater than at the two ends.

Individuals of both sexes appearing in warm seasons are testaceous in colour, with some black patterns, whose areas decrease by the increase of temperature; on the other hand, those individuals which appear in cold seasons are almost black in colour with some small yellow patches on legs and palps. This intimate correlation between temperature and colouration suggests the capability of the species of thermal economy — i.e. in winter the black colouration favours the absorption of infra-red heat rays which in warm weather, is not so much needed, and hence the species turns testaceous.

Genieys (1922) showed that temperature was the only factor that produced decolouration in *Microbracon brevicornis* Wesm.. Schlottke (1926) in the case of *Habrobracon juglandis* Ashmead (*Microbracon hebetor* Say) showed that formation of pigment decreases with the increase of temperature; and that pigmentation was deposited particularly at muscle attachments.

Number of generations

The species is multivoltine with 5 to 7 generations and numerous broods every year. The variation in the number of generations is largely due to the temperature prevailing during the breeding season. In Australia, the insect has eight generations (Schwell, 1928).

Quiescent period

Hase (1922) in Germany conjectures that the species hibernates "as pupa and adult." Schwell (1928) in Australia showed that the insect hibernated as female, probably a virgin female. Richards and Thomson (1932) think that in England it hibernates as pupa. The present writer concludes on the following evidence that *Microbracon hebetor* Say hibernates in the state of female, mated as well as virgin. This conclusion was arrived at in two ways :

(1) Collecting in the field and keeping the collected material under observation at room temperature varying from 12-16° C. in winter and from 16-22° C. in autumn and spring.

(2) Breeding in the laboratory for two seasons under the same temperature conditions mentioned above. These conditions do not very much differ from the natural conditions in wharves and warehouses.

In collecting the writer noticed that in winter females were found though not in large numbers, that males were not found at all (in rooms of warehouses where new consignments were stored, some males were found, apparently introduced from abroad — but my collecting was carried on in rooms where no new stuff was stored) and that eggs, larvae, prepupae and pupae were seldom met with. This gave a preliminary suggestion that the species probably hibernated as a female. Individuals of every stage were collected as shown in Table XII and were kept under observation. Males generally died 1 to 8 days after collecting ; eggs, larvae, prepupae and pupae collected in autumn either completed their development or died ; those few collected in winter all died without further development, certain number of the females died and the rest came through the winter and started breeding in spring.

TABLE XII

Hibernation field collection 1930-1931

STAGE	TIME OF COLLECTING				TOTAL	THOSE WHO PASS WINTER IN SAME STAGE
	September	October	November	December		
Eggs	82	77	0	0	159	0
Larvae	68	54	14	12	148	0
Cocoons	91	84	99	24	298	0
Males	121	69	0	0	180	0
Females	125	411	289	86	911	536

Breeding in the laboratory was started with two aims :

(1) To check the data obtained from field collecting

(2) If the female is the hibernating stage to ascertain whether she hibernates as a mated or as a virgin female. The result obtained and recorded on Table XIII confirmed those of field experiments that females are the only stage that survive the winter. In the second question breeding showed that females hibernate some as mated and some as virgin females.

This finding is made more intelligible than Schwell's suggestion that the species hibernates as a virgin female when we consider the following facts :

The species is parthenogenetic and parthenogenesis here is of the arrhenotokous type ; now, in spring the first generation of many hibernating females consists of males as well as females ; this cannot happen if the mother is a

virgin female. Furthermore, in order to preserve the species this suggested hibernating virgin has got to be mated sometime, the earliest chance she would get is in the early spring when the first generation of males appears, that is, when she is at least 14 weeks old; at this age the chances of a female accepting a male are very few and if mating occurs then, it is usually unsuccessful and the resulting progeny is all males, and that is detrimental to the species.

TABLE XIII

Results of hibernation breeding experiments

STAGE	SEASON 1930-1931		SEASON 1931-1932	
	NUMBER OF INDIVIDUALS DEALT WITH	NUMBER OF INDIVIDUALS WHO SURVIVED WINTER IN SAME STAGE	NUMBER OF INDIVIDUALS DEALT WITH	NUMBER OF INDIVIDUALS WHO SURVIVED WINTER IN SAME STAGE
Eggs	160	0	725	0
Larvae	132	0	842	0
Prepupae	56	0	318	0
Pupae	42	0	476	0
Males	123	0	650	0
Virgin females	47	40	107	76
Mated females	22	18	84	63

That females do not accept males at "old" age, and that if a male can by force overcome an "old" female and actually succeeds in mating her, this mating fails to fertilise the female, is deduced from the following experiment.

On the fourth of April 1932, each of 10 virgin females, which had emerged during the period 10-19th of November 1931, and which passed the winter in hibernation, was isolated with two young males (2 days old), and kept under observation. All environmental conditions were favourable for mating. The result was, that five females successfully resisted the males and would not be mated. The other five, after long resistance, were overpowered by the males and mated; two of these last five females died before laying any eggs; the remaining three females laid 82 eggs and died, one on the 15th and two on the 16th of April 1932; 36 imagos came out of these 82 eggs, and all of them were males. This shows that the females were not fertilised.

Hibernation in *Microbracon hebetor* Say can be brought to an end if the hibernating female is subjected to favourable temperature conditions. In

nature if a spell of warm weather, i.e. over 17° C., sets in during winter, the hibernating female may lay some eggs, they sometimes sting hosts and feed on them at 15° C.. In the laboratory the insect could be successfully bred the whole year round under favourable temperature conditions (22-30° C.). All this shows that hibernation here is not a state of real dormancy but is only a quiescent state (7).

In warehouses and wharves hibernating females are usually found in dark places, mostly, corners, crannies and crevices in the walls and ceilings, and between the rafters where they lie motionless with their antennae resting backwards on the dorsal side, and the whole ventral surface of the body in contact with the strata, probably to lessen the amount of evaporation. If disturbed during their quiescence they slightly move.

In one instance, November 1931, a female did not emerge from the cocoon when she was fully mature, but hibernated inside the cocoon as a full mature imago and emerged in February 1932.

X. OVIPOSITION

Egg-laying does not start until the host is completely paralysed. A constant temperature stimulates oviposition more than a varying one. Usually *Microbracon hebetor* Say attacks its host when the latter is in its late instars and in a healthy condition. The last instar is preferred.

Much patience is required if one wishes to see *Microbracon hebetor* Say in the act of ovipositing. She takes quite a long time, sometimes as long as three hours, inspecting the paralysed caterpillar and its surroundings, using the tip of the ovipositor as a feeler When the female starts egg-laying she gets a good hold and then curves the much dilated abdomen under her. The ovipositor is extended to its full length being held between, and guided by, the ovipositor palpi. Apparently great effort and exertion is needed in extruding the comparatively big egg. The egg appears at the middle part of the ovipositor and slowly slides down between the sheath until it is gently laid on the substratum. The female is not very easily disturbed during oviposition. After a certain number of eggs has been laid — the number differing according to conditions — the female stops laying until she is supplied with another host. Eggs are never laid haphazardly.

Usually the eggs are laid on the substratum either under the victim's body or at the sides; on some occasions they are laid on the body itself,

(7) Shelford (1929, p. 150) suggested that the two synonymous terms "Dormancy" and "Diapause" should be restricted to cases in which activity or development is spontaneously arrested. The cases in which activity or development is interrupted by the direct influence of unfavourable conditions and is resumed as soon as the conditions become favourable are referred to as quiescent stages and do not come under head of dormancy or diapause.

and in this case they may sometimes be seen leaning against one of the spires of the host. Eggs are laid singly or in clusters of 2 to 7 and never far from the the host (see Fig. 1).



Fig. 1. — Position of the eggs of *Microbracon hebetor* Say laid on *Ephestia* caterpillar.

XI. PERIOD OF OVIPOSITION

The female is ready to oviposit 14 to 48 hours after emerging from the cocoon, and under favourable conditions goes on laying during the whole period of her life, stopping 1 to 2 days before death.

XII. TOTAL NUMBER OF EGGS LAID BY A SINGLE FEMALE UNDER ROOM-TEMPERATURE

The writer did not find any significant difference in the number of eggs laid by virgin and mated females.

Three females bred by Hase (1922) laid 317, 257 and 201 eggs consecutively, with an average of 258.3 eggs for a single female; 34 females ([8]) bred by the present writer on *Ephestia kühniella* Z. at room temperature of 17-28° C. laid an average of 187.44 eggs; the lowest number of eggs laid being 76 eggs, and the highest 362 eggs. The detailed data are given in Table XV.

XIII. INFLUENCE OF TEMPERATURE ON OVIPOSITION

The temperature at which females are kept, markedly influences oviposition. Under the temperature of 15° C. and over 41° C. no eggs are laid. Hase's figure for the lower limit of oviposition is also 15° C., but he did not work out the upper limit. The following experiment illustrates the effect of temperature on oviposition.

Five batches of 10 females each, were kept at different temperatures for four days, each female being supplied with a fresh full grown larva of *Ephestia kühniella* Z. every 24 hours. The eggs laid on the first day were not counted. Table XIV shows the number laid by each batch of ten females.

([8]) All these 34 females lived until they died of old age; all females which died through accidents, etc., were eliminated.

TABLE XIV

Number of eggs laid by 5 batches of 10 females in three days at different temperatures

TEMPERATURE IN °C.	NUMBER OF EGGS
18 ± 1	381
22 ± 1	435
26 ± 0 5	560
30 ± 0.5	636
34 ± 0.5	683

It must not be inferred from this that the total number of eggs laid by a female would necessarily increase by increasing the temperature, because high temperature shortens the life of the insect; it is merely a case of accelerating the rate of oviposition.

XIV. STERILE EGGS

It is the experience amongst some entomologists to judge the fecundity of a species by the number of eggs laid by the female. In *Microbracon hebetor* Say this principle would be extremely misleading, because an average percentage of 39.54 % of the eggs laid do not develop (⁹) ; soon after oviposition these eggs shrivel up without showing any signs of embryonic development. Of the previous workers, the only one who described this phenomenon in the species is Hase (1922), whose finding the writer confirms and extends. Berliner (1911), Whiting (1918 and 1921), Schwell (1928) and Myers (1929) all made no mention of sterile eggs in their papers.

These sterile eggs are laid haphazardly amongst the normal eggs and at first one cannot differentiate between them until the normal eggs begin to develop and sterile can be detected by their opaque appearance and by the fact that they soon shrivel; they are laid by virgins as well as by mated females, and independent of age and season.

Sterile eggs seem to be of common occurrence among many insects and though the phenomenon is of important economic and cytological interest, it has received the attention of comparatively few investigators.

Table XV shows percentage of sterile eggs in 34 females.

(⁹) For details see Table XV.

Table XV

Total number of eggs laid by females of *Microbracon hebetor* Say, number of sterile eggs, number of adult progeny, and their percentage to total number of eggs laid

Serial Number	Total Number of Eggs Laid	Number of Sterile Eggs	Number of Adult Progeny	Percentage of Sterile Eggs to Total Number of Eggs Laid	Percentage of Progeny to Total Number of Eggs Laid
1	127	52	27	40.94	21.26
1	91	43	38	47.25	41.75
3	220	98	96	44.54	43.63
4	181	97	63	53 59	34.81
5	138	63	49	45.65	35 51
6	132	59	55	44 70	41.66
7	156	48	36	3 .76	23.07
8	120	45	64	37.50	53.33
9	285	126	128(74 females + 54 males)	44.21	44 81
10	67	33	22(15 females + 7 males)	49.25	32.83
11	86	32	37(23 females + 14 males)	37.21	42.52
12	159	57	62(39 females + 23 males)	35.84	39.99
13	276	89	123	32.29	44.56
14	253	95	118(37 females + 81 males)	37.54	46.64
15	97	23	58	23.71	59.79
16	256	114	98	44.53	38.28
17	117	28	67(26 females + 41 males)	23.93	53 85
18	124	60	38(22 females + 16 males)	48.38	30.64
19	192	89	76	46.87	39.58
20	136	61	52(20 females + 32 males)	48.85	38.23
21	296	102	114	34 46	38.52
22	245	115	97(62 females + 35 males)	46.93	39.59
23	234	99	101	42.30	43.17
24	93	27	47(25 females + 22 males)	29.02	50.53
25	273	106	137	38.09	50 18
26	168	52	91	30.95	53 57
27	134	54	46	40.29	34 32
28	109	46	39(21 females + 18 males)	42.20	35.78
29	312	120	111	38.46	35.57
30	362	124	123	37.01	33.99
31	321	126	129	39.25	40.02
32	145	34	86	23 45	59 31
33	245	99	108	40.40	44.08
34	223	96	102	43.41	45.74
Average number of eggs laid by one female = 187 44 Percentage of sterile eggs = 39·354 Percentage of progeny = 41.64					

XV. RELATION OF PARASITE LARVA TO HOST

After hatching, the young parasite, finding itself on or very near to the caterpillar which has been rendered helpless by its mother, soon begins feeding and grows rapidly. If about a centimetre from the host or if it has been accidentally moved away from it, the parasite cannot reach its food. If the distance is less than one centimetre the larva may be able to find the host, though in most cases it wanders about helplessly, creeping in all directions; in the end shrivelling and dying. From the time it emerges until it leaves the host for spinning its cocoon, the parasite larva never stops feeding except for three intervals during which it moults.



Fig. 2. — ***Microbracon hebetor*** Say larvae parasitising *Ephestia* caterpillar.

During the whole feeding period *Microbracon hebetor* Say larva hangs externally to the body of the host (see Fig. 2), held in position by means of the small spines on its body and probably by the integumental secretion which keeps it wet and sticky. It is very easy to pick a larva from the host by means of a small brush, but it is not so easy to do so by means of a thin glass rod with smooth rounded end, and it is really difficult to shake the larva off its host. This gives an idea of the utility of the spines.

The parasite larvae do not move very much during their feeding period, unless they are crowded on their host. They then move, but the distance through which they go is only about four or five millimetres and the movement is accomplished as follows :

The posterior part of the body is fixed to the substratum, the head and anterior part of the body are raised, extended to their fullest length and then fixed to the substratum. The posterior part of the body is now lifted, contracted to its minimum length, and then fixed again to the substratum and so on.

XVI. NUMBER OF HOSTS PARALYSED BY A FEMALE

The number of hosts which a female paralyses differ (1) at different temperature, and (2) with different hosts.

(1) At the temperatures of 20 ± 1° C., 24 ± 1° C. and 32 ± 0.5° C. out of 20 *Ephestia kühniella Z.* larvae, the average number of hosts paralysed by one female in 24 hours was 7, 9.3 and 14. The female *Microbracon* was left at the temperature of the experiment for 12 hours and then introduced into a petri

dish ([10]) containing 20 full grown *Ephestia* larvae. The dish with its contents was then left in the incubator for 24 hours. Each experiment was repeated twice each time with a different young female; the details of results are shown in Table XVI.

TABLE XVI

Number of hosts paralysed by a female of *Microbracon hebetor* Say at different temperatures

TEMPERATURE IN °C.	NUMBER OF HOSTS PARALISED OUT OF 20 HOSTS SUPPLIED			
	First experiment	Second experiment	Third experiment	Average
20 ± 1	7	5	9	7
24 ± 1	11	9	8	9.3
32 ± 0.5	14	12	16	14

(2) Three females were chosen at random from 50 virgins 5 days old. Each female was introduced into an ordinary insect pill-box 7.62 cms. (3 inches) in diameter and 2.54 cms. (1.0 inch) deep. In one of the pill-boxes were 25 full grown *Ephestia kühniella* Z. larvae, in the 2nd there were 25 full grown *Plodia interpunctella* Hb. larvae and in the third 25 *Galleria mellonella* L. larvae, these three pill-boxes were left at summer room temperature (24-26° C.) for 24 hours and then examined. From the *Ephestia* larvae 14 were paralysed, from the *Plodia* 18 were paralysed and from *Galleria* only 6 were paralysed; the experiment was repeated with another three females and the numbers paralysed were 12, 19, 4 of *Ephestia, Plodia* and *Galleria* respectively.

To investigate the utmost number a female may sting, the following experiment was carried out :

Two virgin females chosen at random, from 50 females 3 days' old, were kept in breeding tubes at 26 ± 1° C., and every morning each female was supplied with a host of *Ephestia*, as soon as the host was paralysed, another was supplied. After 4 o'clock in the afternoon no new hosts were given, and the females were left with hosts they have until next morning, so that they release themselves of eggs they may want to lay. One of the females lived 14 days and paralysed 86 hosts, the other lived 18 days and paralysed 93 hosts.

Hase conducted a series of laboratory experiments to ascertain whether under favourable conditions a female *Microbracon* stung all full grown hosts placed with her or whether a certain number escaped the attack. He found

([10]) The petri dish was 9.1 cms. in diameter and 1.7 cm. deep.

that as long as the numerical ratios of *Microbracon* to *Ephestia* was 1 : 1 or 1 : 2, all caerpillars were paralysed, but when the caterpillars stood higher than the mentioned ratios a certain number escaped destruction.

XVII. NATURAL ENEMIES

No hyperparasites were found on the egg stage of *Microbracon hebetor* Say. In the larval stage, there is a certain amount of cannibalism, and, when the host is badly attacked by bacteria (*Bacillus thuringiensis*), the parasitic larvae are usually infected and soon succumb. The pupal stage is subject to the attacks of the early instars of *Ephestia* and *Plodia* which devour them. In rare cases the full grown *Ephestia* larvae devours the adults which get entangled in the web and cannot effectively use their sting. *Galleria mellonella* L. larvae attack the adults more seriously than *Ephestia* or *Plodia*.

XVIII. SUMMARY

(1) Previous works on *Microbracon hebetor* Say are shortly reviewed.

(2) The habitat of the species is here described as places like mills, warehouses, docks, and seed stores.

(3) Food of larva, of female and of male is described. There is a correlation between food and function in these stages. The larva being the growing stage of the species needs nitrogenous food during all the period of her life. The female needs nitrogenous food only during egg laying period. The male, and female when not laying, do not need any nitrogenous food. The source of this nitrogenous food is certain small caterpillars (*Ephestia*, *Plodia* and *Galleria*) which *Microbracon hebetor* Say parasitises.

(4) Hatching is described. Before eclosion embryo swallows amniotic fluid and air. Gas appears in the trachea before eclosion. Antennae are the organs which pierce the chorion and not mandibles as described by Hase (1922).

(5) Duration of life in imago is described. Females live longer than males. Under room temperature conditions, female lives 51.80 days in summer, 71.98 days in autumn and when she goes through hibernation she lives 144.24 days. Males which mate live 12-14 days, males which do not mate live 14-16 days. There is no difference in longevity of mated and virgin females. Duration of life is compared when insect is (a) starved, (b) given water only, (c) given sugar solution 5 %.

(6) Parthenogenesis is described. It is of the arrhenotokous type, but two isolated instances of deuterotokous are recorded.

(7) Complete life history is described. In England the first generation appears March-May, 4-6 generations follow until late in November when breeding stops and the species hibernates as mated and virgin females.

(8) Influence of temperature on oviposition is described. 15° C. is the lower limit for egg laying, 41° C. is the higher. A correlation between rise in temperature and increase in number of eggs laid is noticed between 18-34° C.

(9) The female is ready to oviposit 14-48 hours after emerging. In room temperature the average number of eggs laid by single female is 187.44, the highest being 362 and the lowest 67. 39.35 % of the eggs are sterile.

(10) Number of hosts paralysed by a female differs at different temperatures and with different hosts.

(11) No hyperparasites were found. Certain amount of cannibalism was noticed. Bacterial infection from hosts affect the larvae. The pupal stages are subject to attacks of the early instars of *Ephestia* and *Galleria* larvae.

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BULLETIN BIBLIOGRAPHIQUE

(Faune d'Egypte)

I

Diagnosi di nuovi *Eumenini* mediterranei

(Hymenoptera)

par A. GIORDANI SOIKA

(Extrait du *Bolletino della Società Veneziana di Storia Naturale*, Vol. II, N° 1, 1938, pp. 1-13)

Liste des espèces décrites ou citées :

Pseudomicrodynerus felinus nov. spec., ♀. — Egypte : Sakkara, une ♀, 26.III.1933. Le Type fait partie de la collection A. Giordani Soika. Le ♂ est inconnu.

Odynerus (*Leptochilus*) *Flegias* nov. spec., ♀. — Sinai : Tor, une ♀, 26.II.1933. Le Type fait partie de la collection A. Giordani Soika. Mâle inconnu.

Odynerus (*Leptochilus*) *camurus* nov. spec., ♀ et ♂. — Egypte : Abou Rawash (les Types), 10.V.1930, 23.V.1937, 27.VI.1937; Wadi Hoff, 16.V.1937; Le Caire, V.1937 (collections A. Mochi et A. Giordani Soika).

Odynerus (*Leptochilus*) *limbiferoides* nov. spec., ♀ et ♂. — Egypte : Wadi Gerrawi, 8.II.1933, Holotype ♀ (collection A. Giordani Soika). Wadi Hoff, 1897, ♀♀ et ♂♂, parmi lesquels l'Allotype (Schmiedeknecht, Musée de Vienne et collection A. Giordani Soika).

Odynerus (*Leptochilus*) *flexilis* nov. spec., ♀ et ♂. — Egypte : Wadi Hoff, 16 et 17.V.1937, 5 ♀♀ parmi lesquelles l'Holotype; Wadi Digla. 21.IV.1935, Allotype ♂ (collection A. Mochi et A. Giordani Soika); Wadi Galala, 1 ♀, 21-25.III.1935 (collection Ministère de l'Agriculture, Egypte).

Odynerus (*Leptochilus*) *errabundus* nov. spec., ♀ et ♂. — Egypte :

Wadi Hoff, 1 ♂ et 2 ♀♀, parmi lesquels l'Holotype et l'Allotype, 18.X.1936 et 21.II.1937 ; Wadi Garrawi, 1 ♂, 3.III.1935 (collections A. Mochi et A. Giordani Soika) ; Borgash, 1 ♂, 31.VII.1932 (collection A. Giordani Soika).

Odynerus (Leptochilus) osiris Schm.

Odynerus (Leptochilis) Torre-Tassoi nov. spec., ♂. — Egypte : Le Caire, 1 ♂ (Type), collection A. Giordani Soika. La ♀ n'est pas connue.

Odynerus (Leptochilus) Schindleri Guiglia. — Egypte : Ikingi Mariout, 1 ♂ et 2 ♀♀, 16-17.III.1935 ; Abusir, 2 ♀♀ et 1 ♂, 17.IV.1935 ; Dekhela, 1 ♂, 19.III.1935 (collections A. Mochi et A. Giordani Soika).

Odynerus (Leptochilis) Schatzmayri nov. spec. — Sinai : Tor, 1 ♀ (Type), 25.II.1933 (collection A. Giordani Soika). La femelle n'est pas connue.

Odynerus (Leptochilus) Falkenhayni Dusm. — Egypte : Gebel Asfar, 21.III.1935 ; environs du Caire, 20-30.V.1937 (collection A. Mochi).

Odynerus (Leptochilus) Falkenhayni Dusm. var. — Egypte : même localités que la forme typique.

Sur une nouvelle Sous-Famille et deux nouveaux Genres de Tétranyques

(Acarina)

par le Dr. M. TAHER SAYED

(Extrait du *Bulletin du Muséum National d'Histoire Naturelle*, Paris, 2e Série, Tome X, N° 6, 1938, pp. 601-610)

Sont décrits, dans ce travail, la sous-famille Pseudotetranychidae, le genre *Phyllotetranychus*, établi pour la nouvelle espèce *aegyptium* [lire *aegyptiacus*], le genre *Dolichotetranychus* pour l'espèce américaine *floridanus* Banks erronément attribuée par Banks au genre *Stygmaeus*.

Phyllotetranychus aegyptiacus Sayed infeste la face dorsale des feuilles du Dattier (variété Siwah) à Mataanah (Haute Egypte) ; *Dolichotetranychus floridanus* Banks a été observé sur *Cynodon dactyclon* L., *Phragmites communis* et *Ananas sativus* Lindl.

Ce travail comporte de nombreuses illustrations.

III

Ueber die Verbreitung und Formenbildung der Gattung *Stilbum* Spin.

(Hymenoptera : Chrysididae)

von Dr. STEPHAN ZIMMERMANN, Wien

(Extrait des *Archiv für Naturgeschichte*. N.F., Bd. 6, heft 4, 1937, pp. 645-662)

Ce travail définit les diverses formes de *Stilbum*, cite d'Egypte le *Stilbum cyanurum cyanurum* Forst. et le *Stilbum cyanurum splendidum* F., et donne une nomenclature des Hyménoptères (Sphegides, Vespides et Apides) aux dépens desquels les *Stilbum* vivent.

IV

A remarkable new ant-like Lygaeid from Egypt

(Hemiptera-Heteroptera)

by W. E. CHINA, M.A.

(Extrait de *The Proceedings of the Royal Entomological Society of London*, Series B [Taxonomy], Vol. 5, part 8, 1936, pp. 164-167).

Dans cet article est décrite une nouveauté de la sous-famille des *Rhyparochrominae* (tribu des Myodochini) : *Aegyptocoris* gen. nov. *myrmecoides* spec. nov.

Habitat : Kafr Hakim (3 ♀♀ brachyptères, y compris le type), 13.XII.1933; Kafr Hakim (2 ♀♀ brachyptères), 14.II.1934; Magadlah (1 ♀ macroptère), Novembre 1934. — Vit sous une graminée (*Imperata cylindrica* (L.) P.B.), communément nommée Halfa.

La description est accompagnée de figures.

BULLETIN

DE LA

SOCIÉTÉ FOUAD Ier D'ENTOMOLOGIE

TABLES DES MATIÈRES

DU

VINGT-CINQUIÈME VOLUME

1941

Table alphabétique par noms d'auteurs

Table des Espèces Nouvelles décrites dans ce volume

(Les noms en italiques désignent les descriptions)

Hymenoptera

BULLETIN

DE LA

SOCIÉTÉ FOUAD Ier D'ENTOMOLOGIE

FONDEE LE 1er AOUT 1907

ancıennement:

Société Entomologique d'Egypte (1907-1922)
et ***Société Royale Entomologique d'Egypte*** (1923-1937)



Placée sous le Haut Patronage du Gouvernement Egyptien
par Décret Royal en date du 15 Mai 1923

Année 1941

LE CAIRE
IMPRIMERIE P. BARBEY

1941

Date de parution et de distribution du présent Volume :
31 Décembre 1941

Le Rédacteur en Chef :
A. ALFIERI

DÉCRET DONNANT LE NOM DE
FOUAD PREMIER
A DES INSTITUTIONS PUBLIQUES CRÉÉES SOUS SES AUSPICES [1]

Nous, FAROUK Ier, Roi d'Egypte,

Sur la proposition du Président de Notre Conseil des Ministres tendant à perpétuer le souvenir de feu le Roi Fouad Premier et à glorifier son nom, vu que son règne s'est distingué par des œuvres éminentes dans le domaine des réformes et par la création de maintes institutions publiques dont la réalisation s'est accomplie grâce à ses conseils et à sa sollicitude, ce qui a eu la plus grande influence sur l'orientation et le développement de la renaissance scientifique, littéraire, sociale et économique de l'Egypte;

Sur l'avis conforme de Notre Conseil des Ministres;

DECRETONS

Art. 1. — Le nom de Fouad Premier est donné aux institutions et établissements indiqués au tableau annexé au présent décret. [2]

Art. 2. — Le Président de Notre Conseil des Ministres est chargé de l'exécution du présent décret, qui entrera en vigueur dès sa publication au « Journal Officiel ».

Fait au Palais de Montazah, le 11 Gamad Tani 1357 (7 Août 1938).

FAROUK

Par le Roi :

Le Président du Conseil des Ministres p.i.
ABDEL FATTAH YÉHIA

(Traduction)

(1) Extrait du *Journal Officiel* du Gouvernement Egyptien, N° 94, du Jeudi 11 Août 1938.

(2) Parmi ces institutions et établissements, figure, sub 7 : *Société Fouad Ier d'Entomologie* au lieu de *Société Royale Entomologique d'Egypte.*

DÉCRET NOMMANT LE PRÉSIDENT DE LA SOCIÉTÉ FOUAD Ier D'ENTOMOLOGIE (1)

Nous, FAROUK Ier, Roi d'Egypte,

Vu le Décret du 15 Mai 1923 approuvant les Statuts de la Société Royale d'Entomologie d'Egypte (Société Fouad Ier d'Entomologie) ;

Sur la proposition du Président de Notre Conseil des Ministres et l'avis conforme du dit Conseil;

DECRETONS

Art. 1. — Mahmoud Tewfik Hifnaoui Bey, Ministre de l'Agriculture, est nommé Président de la Société Fouad Ier d'Entomologie.

Art. 2. — Le Président de Notre Conseil des Ministres est chargé de l'exécution du présent décret.

Fait au Palais d'Abdine, le 6 Moharram 1359 (14 Février 1940).

FAROUK

Par le Roi :
Le Président du Conseil des Ministres,
ALY MAHER

(Traduction)

(1) Extrait du *Journal Officiel* du Gouvernement Egyptien, 67ème année, N° 18, du Lundi 19 Février 1940.

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» M. HUGO LINDEMAN, (décédé en 1937).

1932 M. ALFRED REINHART, (décédé en 1935).

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Censeurs

M. le Dr. A. AZADIAN et M. E. KAOURK.

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EN 1941

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1934 Paoli (Prof. Guido), Directeur du R. Osservatorio per le Malatie delle Piante, 1, Via Marcello Durazzo, Gênes, Italie.

Schatzmayr (A.), Museo Civico di Storia Naturale, Corso Venezia, Milano, Italie.

1927 Williams (C.B.), Rothamsted Experimental Station, Harpenden, Herts, Angleterre.

Membres Titulaires

1913 Abaza Pacha (S.E. Fouad), Directeur Général de la Société Royale d'Agriculture, Boîte Postale N° 63, au Caire.

1941 Abou El Fath (Mohamed), Département d'Entomologie, Faculté d'Agriculture, Université Fouad I^{er}, Rue El-Madares, Ghizeh, près le Caire.

1923 Agricultural Research Institute (The Librarian), Wad Medani, Soudan.

1908 Alfieri (Anastase), Secrétaire Général et Conservateur de la Société Fouad I^{er} d'Entomologie, Boîte Postale N° 430, au Caire.

1941 Amin El Dib (Abdel Latif), Département d'Entomologie, Faculté d'Agriculture, Université Fouad I^{er}, Rue El Madares, Ghizeh, près le Caire.

1938 Attia (Rizk), Section d'Entomologie, Ministère de l'Agriculture, Dokki (Ghizeh), près le Caire.

1924 Azadian (Dr. A.), Laboratoires d'Hygiène Publique, au Caire.

1938 Bailey Bros and Swinfen Ltd., Cathedral House, 8-11, Paternoster Row, Londres, E.C. 4, Angleterre.

1939 Bechir (Mahmoud), Section de Protection des Plantes, Ministère de l'Agriculture, Dokki (Ghizeh), près le Caire.

1929 BICHARA (Ibrahim), Section d'Entomologie, Ministère de l'Agriculture, Dokki (Ghizeh), près le Caire.

1938 BLANCHETEAU (Marcel), Aux Amateurs de Livres, 56, Faubourg Saint-Honoré, Paris (VIII[e]).

1939 BLARINGHEM (Louis), de l'Institut de France, Conservateur de l'Arboretum G. Allard, 77, Rue des Saints Pères, Paris (VI[e]), France.

1923 BODENHEIMER (Prof. F.S.), Hebrew University, Jerusalem, Palestine.

1938 CARNERI (Alexandre), Librairie Elpénor, 10, Rue Chakour Pacha, Alexandrie.

1929 CASSAB (Antoine), Section d'Entomologie, Ministère de l'Agriculture, Dokki (Ghizeh), près le Caire.

F CHAKOUR (Edgard), Secrétaire Général de la Société Anonyme des Eaux du Caire, Rue Foum El-Teraa El-Boulakia, au Caire.

1931 COMPAGNIE UNIVERSELLE DU CANAL MARITIME DE SUEZ, 20, Rue Dar El-Chefa, Kasr el Doubara, au Caire.

1934 CRÉDIT FONCIER EGYPTIEN (Monsieur l'Administrateur Délégué), Rue Malika Farida, au Caire.

1938 DIRECTORATE OF AGRICULTURE, Ministry of Economics and Communications, Baghdad, Irak.

1928 DOLLFUS (Robert Ph.), Museum National d'Histoire Naturelle, 57, Rue Cuvier, Paris (V[me]), France.

1919 EFFLATOUN Bey (Hassan C.), Professeur d'Entomologie et Vice-Doyen de la Faculté des Sciences, Université Fouad I[er], Abbassieh, au Caire.

1934 FACULTÉ D'AGRICULTURE, Université Fouad I[er], Rue El-Madares, Ghizeh, près le Caire.

1941 FAHMY (Aly), Section d'Entomologie, Ministère de l'Agriculture, Dokki (Ghizeh), près le Caire.

1940 FARGHAL ALY (Mohamed), 35, Rue Akef, Abbassia, au Caire.

1914 GARBOUA (Maurice), 1, Rue Soliman Pacha, au Caire.

1938 Ghabn (Dr. Abdel Aziz), Section d'Entomologie, Ministère de l'Agriculture, Dokki (Ghizeh), près le Caire.

1927 Ghali Pacha (S.E. Wacef Boutros), Avenue de Ghizeh, près le Caire.

1938 Ghesquière (J.), 87, Avenue du Castel, Bruxelles (W. St L.), Belgique.

1921 Greiss (Elhamy), Département Botanique, Faculté des Sciences, Université Fouad I^er^, Abbassieh, au Caire.

1936 Hafez (Dr. Mahmoud), Ph. D., Département d'Entomologie, Faculé des Sciences, Université Fouad I^er^, Abbassieh, au Caire.

1938 Hamza (Soliman), Section d'Entomologie, Ministère de l'Agriculture, Dokki (Ghizeh), près le Caire.

1930 Hanafy Bey (Mahmoud), 12, Rue Akhshid, Manial El Roda, près le Caire.

1938 Hanna (Dr. Assaad Daoud), Section d'Entomologie, Ministère de l'Agriculture, Dokki (Ghizeh), près le Caire.

1928 Hassan (Dr. Ahmed Salem), Professeur de Zoologie et d'Entomologie à la Faculté d'Agriculture, Université Fouad I^er^, Rue El-Madares, Ghizeh, près le Caire.

1941 Heath Davies (Madame D. M.), 8, Rue Birgas, Garden City, au Caire.

1940 Hifnaoui Bey (Prof. Mahmoud Tewfik), Président de la Société Fouad I^er^ d'Entomologie, Rue Lazogly, Hélouan, près le Caire.

1932 His Majesty Stationery Office, Princes Street, Westminster, S.W.1, London, Angleterre.

1925 Hocheiry Bey (Abd-El-Baki Zaki El), ancien Conseiller à la Cour d'Appel Indigène, 22, Rue Abou El-Feda, Zamalek, au Caire.

1924 Honoré (Dr. A.), Chimiste, Raffinerie de Hawamdieh, Haute-Egypte.

1927 Housny (Mahmoud), Section d'Entomologie, Ministère de l'Agriculture, Dokki (Ghizeh), près le Caire.

1938 IBRAHIM (Abdel Hamid), Section d'Entomologie, Ministère de l'Agriculture. Dokki (Ghizeh), près le Caire.

1940 IBRAHIM (Ahmed Housny), Section d'Entomologie, Ministère de l'Agriculture, Dokki (Gkizeh), près le Caire.

IBRAHIM ZEID (Mahmoud Mohamed), Département d'Entomologie, Faculté d'Agriculture, Université Fouad Ier, Rue El-Madares, Ghizeh, près le Caire.

1936 IMPERIAL CHEMICAL INDUSTRIES (EGYPT) S.A., 26, Rue Madabegh, au Caire.

1938 ITRIBI (Abbas El), Section d'Entomologie, Ministère de l'Agriculture, Dokki (Ghizeh), près le Caire.

1928 IZZET Bey (Mohamed), 14, Midan El Daher, au Caire.

1915 JULLIEN (Joseph), 215, Rue de Thèbes, Cléopâtra-les-Bains, Ramleh.

1927 KAMAL (Dr. Mohamed), Cotton Research Board, Ministère de l'Agriculture, Rue El-Madares, Ghizeh, près le Caire.

1941 KAMEL EL SAWAF (Saleh), Département d'Entomologie, Faculté d'Agriculture, Université Fouad Ier, Rue El-Madares, Ghizeh, près le Caire.

1922 KAOURK (Elias A.), Avocat, c/o Egyptian Markets Co Ltd, 136, Rue Emad El Dine, au Caire.

1926 KASSEM (Mohamed), Section d'Entomologie, Ministère de l'Agriculture, Dokki (Ghizeh), près le Caire.

1938 KLEIN (Henry Z.), Agricultural Research Station, Rehovoth, Palestine.

1923 LABORATOIRES D'HYGIÈNE PUBLIQUE, Bibliothèque de la Section d'Helminthologie, au Caire.

1931 LAND BANK OF EGYPT (Mons. l'Administrateur-Directeur de la), Boîte Postale No 614, Alexandrie.

1934 LOTTE (Dr. F.), Médecin de la Compagnie Universelle du Canal Maritime de Suez, Boîte Postale No 222, Port-Saïd.

1937 LOUTFY (Abdel Aziz), Section de la Protection des Plantes, Ministère de l'Agriculture, Dokki (Ghizeh), près le Caire.

1931 LYCÉES FRANÇAIS, 2-4, Rue Haouayati, au Caire.

1932 • MADWAR (Dr. Saadallah Mohamed), Fouad I[st] Institute and Hospital for Tropical Diseases, 10, Rue Kasr El Aini, au Caire.

» MALUF (Dr. N. S. RUSTUM), Department of Zoology, The Johns Hopkins University, Charles and 34th Streets, Baltimore, Maryland, Etats-Unis d'Amérique.

1927 MANSOUR (Prof. Dr. Kamel), D. Sc., Département de Zoologie, Faculté des Sciences, Université Fouad I[er], Abbassieh, au Caire.

1921 MISTIKAWY (Abdel Megid El), Sous-Directeur de la Section de la Protection des Plantes, Ministère de l'Agriculture, Dokki (Ghizeh), près le Caire.

1933 MOCHI (Prof. Dr. Alberto), Villa i Sarici, Collina, presso Pistoia, Italie.

1940 MOHAMED (Ibrahim Nour El Din), B. Sc (Faculté d'Agriculture, Université Fouad I[er]), 5, Rue Afrah El Anghal, Mounira, au Caire.

1929 MOSSERI (Henri), 25, Rue Cheikh Abou El Sebaa, au Caire.

1940 NOUR EL DIN (Ahmed), Section d'Entomologie, Ministère de l'Agriculture, Dokki (Ghizeh), près le Caire.

1939 PANTOS (Jean G.), Ingénieur Agronome, Boîte Postale N° 411, Kampala, Uganda.

1911 PETROFF (Alexandre), 27, Rue Grafton, Bulkeley, Ramleh.

1928 PRIESNER (Prof. Dr. H.), au Caire.

1932 RIVNAY (E.), Agricultural Research Station, Rehovoth, Palestine.

1925 ROYAL ENTOMOLOGICAL SOCIETY OF LONDON (The), 41, Queen's Gate, South Kensington, S.W. 7, Londres, Angleterre.

1936 SAYED (Dr. Mohamed Taher), Section d'Entomologie, Ministère de l'Agriculture, Dokki (Ghizeh), près le Caire.

1938 SHAFEI (Mohamed Aly Ismail El), 18, Midan Mohamed Aly, au Caire.

» SHAFIK (Dr. Mohamed), Directeur Technique de la Société Financière et Industrielle d'Egypte, Boîte Postale N° 7, Kafr Zayat, Basse Egypte.

1924 SHAW (Fred), Northgate, Sherborne, Dorset, Angleterre.

1938 SOCIÉTÉ DU NAPHTE S.A. (A.I. Mantacheff & Co.), 33, Rue Madabegh, au Caire.

1921 SOCIÉTÉ ROYALE D'AGRICULTURE, Laboratoire d'Entomologie de la Section Technique, Boîte Postale N° 63, au Caire.

1934 SOLIMAN (Prof. Dr. Hamed Seleem), Faculté d'Agriculture, Université Fouad Ier, Rue El-Madares, Ghizeh, près le Caire.

1928 SOLIMAN (Dr. Labib Boutros), Section d'Entomologie, Ministère de l'Agriculture, Dokki (Ghizeh), près le Caire.

1926 TEWFIK (Mohamed), Assistant Entomologiste, Faculté des Sciences, Université Fouad Ier, Abbassieh, au Caire.

1935 TRACTOR COMPANY OF EGYPT, S.A.E. (The), 140, Rue Emad El Dine, Boîte Postale N° 366, au Caire.

1926 WALY (Dr. Mohamed), Conférencier en Zoologie, Faculté des Sciences, Université Fouad Ier, Abbassieh, au Caire.

1912 WILKINSON (Richard), Immeuble Baehler, 157, Avenue Fouad Ier, Zamalek, au Caire.

1938 ZOHEIRY (Mohamed Soliman El), Sous-Directeur et Directeur p.i. de la Section d'Entomologie, Ministère de l'Agriculture, Dokki (Ghizeh), près le Caire.

Institutions Scientifiques et Bibliothèques

Afrique Occidentale Française:

Institut Français d'Afrique Noire, Boîte Postale N° 206, Dakar.

Afrique du Sud:

South African Museum, P.O. Box 61, Cape Town.

Department of Agriculture of the Union of South Africa (The Agricultural Journal of the Union of South Africa), Pretoria.

Department of Agriculture of the Union of South Africa, Division of Entomology, P.O. Box 513, Pretoria.

The Director, The Transvaal Museum, P.O. Box 413, Pretoria, South Africa.

The Honorary Secretary, Entomological Society of Southern Africa, P.O. Box 103, Pretoria.

Algérie:

Société d'Histoire Naturelle de l'Afrique du Nord, Faculté des Sciences d'Alger, Alger.

Allemagne:

Deutsche Entomologische Gesellschaft, 43, Invalidenstrasse, Berlin (IV).

Senckenbergischen Naturforschenden Gesellschaft, Bibliothek, Viktoria Allee 9, Frankfurt A/M.

Bücherei des Zoologischen Museums, 43, Invalidenstrasse, Berlin N4.

Gesellschaft für Vorratsschutz E.V. (Mitteilungen der), 31, Zimmermannstrasse, Berlin-Steglitz.

Bücherei der Biologischen Reichsanstalt für Land- und Forstwirtschaft. 19, Königin-Luise-Str., Berlin-Dahlem.

Deutsches Entomologisches Institut der Kaiser Wilhelm Gesellschaft (Arbeiten über morphologische und taxonomische Entomologie, Arbeiten über physiologische und angewandte Entomologie), 20, Gossler Strasse, Berlin-Dahlem.

Deutsche Kolonial und Uebersee-Museum, Bahnhofsplatz, Brême.

Administration-Kanzlei des Naturhistorischen Museums, Burgring 7, Vienne (I).

Zoologisch-Botanische Gesellschaft, 2, Mechelgasse, Vienne (III).

Koleopterologische Rundschau, c/o Zoologisch-Botanische Gesellschaft, 2, Mechelgasse, Vienne (III).

Naturhistorischer Verein der Rheinlande und Westfalens (Entomologische Blätter, Dechemana), 4, Maarflach, Bonn.

Münchner Entomologischen Gesellschaft E.V. (Mitteilungen der), c/o Dr. W. Forster, 51, Neuhauser Strasse (Zoolog. Staatssamlg.), Munich (2).

Angleterre:

The Imperial Institute of Entomology, Review of Applied Entomology, 41, Queen's Gate, London S.W. 7.

Zoological Museum (Novitates Zoologicæ), Tring Park, Tring, Herts.

The Apis Club (The Bee World), The Way's End, Foxton, Royston, Herts.

Cambridge Philosophical Society, New Museums, Free School Lane, Cambridge.

The Librarian, The Zoological Society of London, Zoological Gardens, Regent's Park, London, N.W.8.

The Librarian, Department of Entomology, University Museum, Oxford.

Argentine:

Instituto Biologico de la Sociedad Rural Argentina, Buenos Aires.

Sociedad Cientifica Argentina, 1145, Calle Santa Fé, Buenos Aires.

Sociedad Entomologica Argentina, 665, Calle San Martin, Buenos Aires.

Museo Nacional de Historia Natural « Bernadino Rivadavia », Casilla de Correo N° 470, Buenos Aires.

Ministerio de Agricultura (Boletin del Ministerio de Agricultura de la Nacion), Bibliotheca, 974, Paseo Colon, Buenos Aires.

Australie:

The Australian Museum (Records of the Australian Museum), Sydney, N.S.W.

The Entomologist's Office, Department of Agriculture, Sydney, N.S.W.

The Public Library, Museum, and Art Gallery of South Australia, Box 386 A, G.P.O., Adelaide, South Australia.

The Library of the Division of Economic Entomology, P.O. Box No. 109, Canberra City, F.C.T.

The Linnean Society of New South Wales, Science House, Gloucester and Essex Streets, Sydney, N.S.W.

Belgique:

Société Entomologique de Belgique, Musée Royal d'Histoire Naturelle de Belgique, 31, Rue Vautier, Ixelles-Bruxelles.

Société Scientifique de Bruxelles, Secrétariat, 11, Rue des Récollets, Louvain.

Monsieur A. Moureau, Secrétaire du Bulletin de l'Institut Agronomique et des Stations de Recherches de Gembloux, Institut Agronomique de l'Etat, Gembloux.

Lambillionea, Revue Mensuelle de l'Union des Entomologistes Belges (M. F. DERENNE), 123, Avenue de la Couronne, Ixelles (Bruxelles).

Annales du Musée du Congo Belge, Tervueren.

Association des Ingénieurs sortis de l'Institut Agronomique de l'Etat, à Gembloux, 35, Avenue des Volontaires, Anderghem-Bruxelles.

Brésil:

Museu National do Rio de Janeiro, Rio de Janeiro.

Instituto Biologico, Bibliotheca, Caixa Postal 2821, São Paulo.

Instituto Oswaldo Cruz, Caixa de Correio 926, Rio de Janeiro.

Arquivos do Serviço Florestal, 1008, Jardim Botânico, Rio de Janeiro.

Academia Brasileira de Sciencias (Annaes da Academia Brasileira de Sciencias), Caixa Postal 229, Rio de Janeiro.

Bulgarie:

Institutions Royales d'Histoire Naturelle, Musée Royal d'Histoire Naturelle, Palais Royal, Sofia.

Société Entomologique de Bulgarie, Musée Royal d'Histoire Naturelle, Palais Royal, Sofia.

Société Bulgare des Sciences Naturelles, Musée Royal d'Histoire Naturelle, Palais Royal, Sofia.

Canada:

Entomological Society of Ontario (The Canadian Entomologist & Reports), Guelph, Ontario.

Bibliothèque du Ministère Fédéral de l'Agriculture, Edifice de la Confédération, Ottawa.

Department of Agriculture, Entomological Branch, Ottawa.

Nova Scotian Institute of Science, Halifax.

Chine:

The Lingnan Science Journal, Lingnan University, Canton.

Bulletin of the Biological Department, Science College, National Sun Yat-Sen University, Canton.

Bureau of Entomology of the Chekiang Province, West Lake, Hangchow.

Chypre:

The Cyprus Agricultural Journal (The Office of the Governement Entomologist), Nicosia.

Colombie (République de), Amérique du Sud :

Revista Facultad Nacional de Agronomia, Biblioteca Facultad Nacional de Agronomia, Universitad Nacional, Medellin.

Cuba:

Sociedad Cubana de Historia Natural « Felipe Poey » (Memorias), c/o Dr. Carlos Guillermo Agnayo, 25 N° 254, Vedado, La Havane.

Danemark:

Entomologisk Forening, Zoologisk Museum, Krystalgade, Copenhague.

Egypte:

Bibliothèque du Cabinet de S.M. le Roi, Palais d'Abdine, au Caire.

Bibliothèque privée de S.M. le Roi, Palais d'Abdine, au Caire.

Ministère de l'Agriculture, Bibliothèque de la Section d'Entomologie, Dokki (Ghizeh), près le Caire.

Société Royale d'Agriculture, Bibliothèque de la Section Technique, Boîte Postale N° 63, au Caire.

Union des Agriculteurs d'Egypte, 25, Rue Cheikh Abou El Sebaa, au Caire.

The Bee Kingdom, 60, Rue Menasce, Alexandrie.

Al-Fellaha, Boîte Postale N° 2047, au Caire.

Société Royale de Géographie d'Egypte, 45, Rue Cheikh Youssef, au Caire.

Bibliothèque du Ministère de l'Instruction Publique, Rue El Falaki, au Caire.

The Journal of the Egyptian Medical Association, Kasr El Aini Post Office, au Caire.

Société Fouad Ier d'Economie Politique, de Statistique et de Législation, Boîte Postale N° 732, au Caire.

Institut d'Egypte, Rue Sultan Hussein (ex Rue El Cheikh Rihan), au Caire.

Bibliothèque Egyptienne, Midan Bab El Khalq, au Caire.

Bibliothèque du Musée Agricole Fouad Ier, Dokki (Ghizeh), près le Caire.

Bibliothèque de la Faculté de Médecine, Université Fouad Ier, Rue Kasr El Aini, au Caire.

Bibliothèque de la Faculté des Sciences, Université Fouad Ier, Abbassieh, au Caire.

Equateur (République de l'), Amérique du Sud:

Director General de Agricultura (Revista del Departamento de Agricultura), Quito.

Boletin de la Seccion Agricola del Banco Hipotecario del Ecuador, Apartado 685, Quito.

Espagne:

Instituto Nacional de 2a Ensenanza de Valencia, Laboratorio de Hidrobiologia Espanola, Valencia.

Junta para ampliacion de Estudios e Investigaciones Cientificas, 4, Duque de Medinaceli, Madrid.

Junta de Ciencies Naturales de Barcelona, Museo Municipal, Barcelona.

Real Academia de Ciencias y Artes de Barcelona, 9, Rambla de los Estudios, Barcelona.

Sociedad Espanola de Historia Natural, Museo Nacional de Ciencias Naturales, Hipodromo, Madrid (VI).

Estacion de Patologia Vegetal, Instituto Nacional Agronomico, La Moncloa, Madrid (VIII).

Etats-Unis:

The Research Library, Buffalo Socicety of Natural Sciences, Buffalo Museum of Science, Humboldt Park, Buffalo, New-York.

University of Illinois Library, Exchange Division, Urbana, Illinois.

Library of the American Museum of Natural History, Central Park, West at 79th Street, New-York City.

Pacific Coast Entomological Society (The Pan-Pacific Entomologist), California Academy of Sciences, Golden Gate Park, San Francisco, California.

Academy of Natural Sciences, Entomological Section, Lagon Square, Philadelphia.

Experiment Station of the Hawaiian Sugar Planters' Association, P.O. Box 411, Honolulu, T.H., Hawai.

Hawaiian Entomological Society, c/o Experiment Station of the Hawaiian Sugar Planters' Association, P.O. Box 411, Honolulu, T.H., Hawai.

Carnegie Museum, Department of the Carnegie Institute, Pittsburgh, Pennsylvania.

American Entomological Society, Academy of Natural Sciences, Logan Square, Philadelphia, Pa.

United States Department of Agriculture, Washington, D.C.

General Library, University of Michigan, Ann Arbor, Michigan.

United States National Museum, Smithsonian Institution, Washington, D.C.

Smithsonian Institution Library, Washington, D.C.

Library of the New-York State College of Agriculture and Agricultural Experiment Station, Cornell University, Ithaca, New-York.

New-York Academy of Sciences, New-York.

Pennsylvania State Health Department, Pennsylvania.

University of California Library, Berkeley, California.

University of California, Citrus Experimental Station Library, Riverside, California.

Wisconsin Academy of Sciences, Arts, and Letters, Madison, Wisconsin.

Library, Minnesota Agricultural Experiment Station, University Farm, Saint Paul, Minnesota.

Museum of Comparative Zoology, Harward College, Cambridge, Mass.

The Philippine Agriculturist, Library, College of Agriculture, Agricultural College, Laguna, Philippine Islands.

Editorial Office, The American Midland Naturalist, University of Notre Dame, Notre Dame, Indiana.

Marine Biological Laboratory, Library, Woods Hole, Mass.

Finlande:

Societas Entomologica Helsingforsiensis, Helsinki.

Societas pro Fauna et Flora Fennica, Kaserngatan 24, Helsinki.

Societas Zoologica-Botanica Fennica Vanamo, Säätytalo, Snellmanstr. 9-11, Helsinki.

Société Entomologique de Finlande (Annales Entomologici Fennici), Institut de Zoologie Agricole et Forestière de l'Université, Snellmaninkatu 5, Helsinki.

France:

L'Echange, Revue Linnéenne, Digoin (Saône et Loire).

Revue française d'Entomologie, Museum National d'Histoire Naturelle (Entomologie), 45 bis, Rue de Buffon, Paris (V^e).

Revue Scientifique du Bourbonnais et du Centre de la France, 22, Avenue Meunier, Moulins (Allier).

Société d'Etudes des Sciences Naturelles de Nîmes, 6, Quai de la Fontaine, Nîmes (Gard).

Société de Pathologie Végétale et d'Entomologie Agricole de France, Laboratoire de Pathologie Végétale, Institut National Agronomique, 16, Rue Claude Bernard, Paris (V^e).

Palarus eximius nov. spec.

Société Linnéenne de Bordeaux, Athénée, 53, Rue Des Trois Conils, Bordeaux.

Société Linéenne de Lyon, 33, Rue Bossuet (Imm. Municipal), Lyon.

Société des Sciences Naturelles de l'Ouest de la France, Nantes (Loire Inférieure).

Association des Naturalistes de Levallois-Perret, 153, Rue du Président Wilson (Domaine de la Planchette), Levallois-Perret (Seine).

Société Linnéenne du Nord de la France, 81, Rue Lemerchier (M. Pauchet), Amiens.

Société Géologique de Normandie et des Amis du Museum du Havre, Hôtel des Société Savantes, 56, Rue Anatole France, Le Havre (Seine Inférieure).

Société d'Histoire Naturelle de Toulouse, Bibliothèque Universitaire de la Faculté de Médecine, Allée Saint-Michel, Toulouse.

Sociéte Entomologique de France, Institut National Agronomique, 16, Rue Claude Bernard, Paris (V^e^).

Société d'Etudes Scientifiques de l'Aude, Carcassone (Aude).

Annales des Epiphyties et de Phytogénétique, Centre National des Recherches agronomiques, à Versailles, France.

Museum National d'Histoire Naturelle, Bibliothèque, 8, Rue de Buffon, Paris (V^e^).

Société de Zoologie Agricole (Revue de Zoologie Agricole et Appliquée), Faculté des Sciences, Institut de Zoologie, 40, Rue Lamartine, Talence (Gironde).

Grèce:

Institut Phytopathologique Benaki, Kiphissia (près Athènes).

Bibliothèque de l'Institut et Musée Zoologique de l'Université, Athènes.

Hollande:

Bibliotheek van der Nederlandsche Entomologische Vereeniging, p/a Bibliotheek van het Kolonial Instituut, 62, Mauritskade, Amsterdam.

Landbouwhoegeschool Laboratorium voor Entomologie, Berg 37, Wageningen.

Hongrie :

Museum National Hongrois (Annales Historico-Naturales), 13, Baross-utca, Budapest VIII.

Indes :

Zoological Survey of India (Records of the Indian Museum), Indian Museum, Calcutta.

Madras Governement Museum, Connemara Public Library, Egmore, Madras.

Office of the Director, Imperial Agricultural Research Institute, New Delhi.

Indes Néerlandaises :

Bibliotheek van het Departement van Economische Zaken, Groote Weg 20, Buitenzorg, Java.

Italie :

Museo Civico di Storia Naturale « Giacomo Doria », 9, Via Brigata Liguria, Genova (102).

Rivista di Biologia Coloniale, 326, Viale Regina Margherita (Policlinico), Roma.

Museo Civico di Storia Naturale di Trieste (Atti del), 4, Piazza Hortis Trieste (10).

Società dei Naturalisti in Napoli, Reale Università, Via Mezzocannone Napoli.

Società Entomologica Italiana, Museo Civico di Storia Naturale, 9, Via Brigata Liguria, Genova (102).

Società Adriatica di Scienze Naturali, 7, Via dell'Annunziata, Trieste.

La Reale Stazione di Entomologia Agraria (Redia), 19, Via Romana, Firenze (32).

La Reale Stazione Sperimentale di Gelsicoltura e Bachicoltura di Ascoli Piceno.

Istituto Zoologico della Reale Università di Napoli (Biblioteca del), Via Mezzocannone, Napoli.

Laboratorio di Zoologia Generale e Agraria del Reale Istituto Superiore Agrario in Portici, Portici (Napoli).

Reale Laboratorio di Entomologia Agraria di Portici (Bolletino del), Portici (Napoli).

Bibliothèque de l'Institut International d'Agriculture (Moniteur International de la Protection des Plantes), Villa Umberto I, Rome (110).

Società italiana di Scienze Naturali, Palazzo del Museo Civico di Storia Naturale, Corso Venezia, Milano.

Istituto di Zoologia della Reale Università di Genova (Bollettino dei Musei di Zoologia e di Anatomia comparata), 5, Via Balbi, Genova.

Società dei Naturalisti e Matematici di Modena, presso la Reale Università, Modena.

Istituto di Entomologia della Reale Università, 6, Via Filippo Re, Bologna (125).

Reale Accademia di Scienze, Lettere ed Arti in Padova, 15, Via Accademia, Padova (Veneto).

Museo di Storia Naturale della Venezia Tridentina (« Memorie del Museo di Storia Naturale della Venezia Tridentina » e « Studi Trentini di Scienze Naturali »), Casella Postale 95, Trento.

Reale Istituto Agronomico per l'Africa Italiana (L'Agricoltura Coloniale), Ministero dell'Africa Italiana, 9, Viale Principe Umberto, Firenze.

Istituto di Entomologia Agraria e Bachicoltura della Reale Università (Bolletino di Zoologia Agraria e Bachicoltura), 2, Via Celoria, Milano (133).

Società Veneziana di Storia Naturale (presso Sig. Antonio Giordani Soika), S. Marco 254, Venezia.

Japon:

Saghalien Central Experiment Station, Konuma, Saghalien.

The Ohara Institute for Agricultural Research, Library, Kurashiki, Okayama-Ken.

Imperial Agricultural Experiment Station (Journal of the), Nishigahara, Tokyo.

Departement of Agriculture, Government Research Institute, Taihoku, Formosa.

The Kansai Entomological Society, c/o N. Tosawa, Shibakawa-Noen, Kotoen, Mukogun, Hyogo-ken.

« Mushii », Entomological Laboratory, Department of Agriculture, Kyushu Imperial University, Fukuoka.

Takeuchi Entomological Laboratory (Tenthredo, Acta Entomologica), Shinomyia Yamashina, Kyoto.

Kenya:

East Africa and Uganda Natural History Society, Coryndon Memorial Museum, P.O.Box 658, Nairobi, Kenya Colony, British East Africa.

Libye :

Museo Libico di Storia Naturale, Piazza Santa Maria degli Angeli, Tripoli d'Africa.

Maroc:

Société des Sciences Naturelles du Maroc, Institut Scientifique Chérifien, Avenue Biarnay, Rabat.

Défense des Végétaux, Service de l'Agriculture et de la Colonisation, Direction des Affaires Economiques, Rabat.

Mexique:

Junta Nacional Directora de la Campana contra la Langosta (Junosta), Biblioteca, Departamento Directivo, Veracruz.

Biblioteca del Instituto Biotecnico, Calzada Mexico-Tacuba N° 295, Col. Anahuac, D.F.

Biblioteca del Instituto de Biologia, Chapultepec (Casa del Lago), Mexico, D.F.

Anales de la Escuela Nacional de Ciencias Biologicas, Apartado Postal 7016, Mexico, D.F.

Norvège :

Tromso Museum Library, Tromso.

Panama (République de) :

Departamento Seccional de Agricultura (Boletin Agricola), Panama.

Pologne:

Musée Zoologique Polonais, Wilcza 64, Varsovie (1).

Société Polonaise des Entomologistes, Rutowskiego 18, Lwow.

Institut de Recherches des Forêts de l'Etat, Wawelska 54, Varsovie.

Portugal:

Société Portugaise des Sciences Naturelles, Instituto de Fisiologia, Faculdade de Medicina, Lisbonne.

Museum Zoologique de l'Université de Coimbra, Largo Marquês de Plombal, Coimbra.

Associçao da Filosofia Natural, na Faculdade de Ciencias, Porto.

Roumanie:

Société Transylvanienne des Sciences Naturelles (Siebenbürgischer Verein für Naturwissenschaften), Hermannstadt, Sibiu.

Academia Romana, Bibliothèque, Calea Victoriei, 125, Bucarest.

Russie (U.S.S.R.):

Société Entomologique de Russie (Revue Russe d'Entomologie et Horae), Musée Zoologique de l'Académie des Sciences, Léningrad.

Bibliothèque de l'Académie des Sciences de l'Ukraine, 58a, Rue Korolenko, Kiew (Ukraine).

Société des Naturalistes de Kiew, 37-10, Rue Korolenko, Kiew (Ukraine).

Institut des Recherches Biologiques de l'Université de Perm, Perm II, Zaimka.

Institute for Plant Protection, Bureau of Applied Entomology and Zoology, Library, 10, Elagin Ostrov, Léningrad.

Rédaction du Journal « Plant Protection », 7, Rue Tschaikovsky, Leningrad.

Institute for controlling Pests and Diseases, Library, 7, Tschaikovsky Str., Leningrad 28.

Siam:

Department of Agriculture and Fisheries, Entomology Section, Bangkok.

Suède :

K. Swenska Vetenskapsakademien i Stockholm, Stockholm 50.

Entomologiska Foreningen, Brottninggatten 94, Stockholm.

Göteborgs Kungl. Vetenskaps-och Vitterhets Samhälles, Göteborg.

Statens Växtskyddsanstalt, Stockholm 19.

Bibliothèque de l'Université de Lund, Lund.

Suisse :

Bibliothèque de la Société Entomologique Suisse, Musée d'Histoire Naturelle, Berne.

Zentralbibliotek, Naturforschenden Gesellschaft, Zurich.

Tchoco-Slovaquie :

Societas Entomologica (Casopis), u Karlova 3, Prague II.

Section Entomologique du Musée National de Prague (Sbornik), Prague II-1700.

Bibliothèque de la Société Zoologique Tchécoslovaque, Institut de Zoologie, Karlov 3, Prague II.

Uruguay (République de l') :

Escuela de Veterinaria del Uruguay (Anales de la Escuela de Veterinaria del Uruguay), Itazaingo 1461, Montévideo.

Sociedad de Biologia de Montevideo, Casilla de Correo 567, Montevideo.

Yougo-Slavie :

Societas Entomologica Jugoslavica (Glasnik), 17, Garasaninovo ulica, Belgrade.

N.B. — Pour changement d'adresse, erreurs ou omissions, s'adresser à Monsieur le Secrétaire Général de la Société Fouad Ier d'Entomologie, Boîte Postale N° 430, au Caire.

PROCES-VERBAUX DES RÉUNIONS

Thé Commémoratif du 28 Janvier 1941

Présidence de Monsieur le Professeur MAHMOUD TEWFIK HIFNAOUI Bey

Allocution du Président :

Mesdames, Messieurs,

Je suis heureux de vous voir réunis ici à l'occasion du 14eme anniversaire de l'inauguration du Siège de la Société par Sa Majesté le Roi Fouad I^{er}, dont la mémoire est toujours vivante et vénérée parmi nous.

Vous savez tous combien ce grand monarque nous a comblé de bienfaits et l'intérêt qu'Il nous a témoigné durant son glorieux règne.

Notre Siège a été solennellement inauguré le 28 Janvier 1928. Quelques années plus tard, et anticipant les besoins de la Société, Sa Majesté le Roi Fouad I^{er} en ordonnait l'extension. Ce qui nous semblait alors l'extrême limite de nos besoins s'avère aujourd'hui insuffisant, nous donnant ainsi une idée de la clairvoyance de notre illustre bienfaiteur.

Je veux espérer que la réunion d'aujourd'hui sera le début d'une plus grande et plus efficace coopération entre tous les membres de la Société et qu'elle servira à resserrer les rapports cordiaux qui vous ont toujours unis.

Séance du 26 Février 1941

Présidence de S.E. FOUAD ABAZA Pacha

Echange de Publications :

Le Conseil approuve l'échange des publications de la Société avec les ANNALES DE L'ACADÉMIE BRÉSILIENNE DES SCIENCES DE RIO DE JANEIRO.

Admission de Membres :

Sur la proposition de Messieurs le Professeur Docteur HAMED SELEEM SOLIMAN et A. ALFIERI, Messieurs MOHAMED ABOU EL FATH, MAHMOUD MOHAMED IBRAHIM ZEID, SALEH KAMEL EL SAWAF et ABDEL LATIF AMIN EL DIB sont admis à faire partie de la Société en qualité de Membres Titulaires.

Séance du 23 Avril 1941

Présidence de Monsieur le Professeur H. C. EFFLATOUN Bey

Don à la Bibliothèque :

Monsieur le Docteur AHMED SALEM HASSAN adresse un exemplaire de son ouvrage sur « *Les insectes d'importance économique en Egypte* », publié en langue arabe, en 1939, au Caire.

Le Conseil remercie.

Admission d'un Membre :

Sur la proposition de Messieurs MOHAMED EL ZOHEIRY et ANTOINE CASSAB, Monsieur ALY FAHMY, de la Section d'Entomologie du Ministère de l'Agriculture, est admis à faire partie de la Société en qualité de Membre Titulaire.

Bureau et Comité Scientifique :

Les élections relatives à la constitution du Bureau du Conseil et du Comité Scientifique pour l'exercice 1941 donnent les résultats qui suivent :

Sont élus : Monsieur le Professeur H. C. EFFLATOUN Bey et Monsieur MOHAMED SOLIMAN EL ZOHEIRY, *Vice-Présidents;* Monsieur ANASTASE ALFIERI, *Secrétaire Général;* Monsieur RICHARD WILKINSON, *Trésorier.*

Sont élus membres du Comité Scientifique : Messieurs le Professeur H. C. EFFLATOUN Bey, le Professeur Docteur KAMEL MANSOUR, le Professeur Docteur HAMED SELEEM SOLIMAN, le Docteur SAADALLAH MOHAMED MADWAR, le Docteur MOHAMED SHAFIK, MOHAMED SOLIMAN EL ZOHEIRY et ANASTASE ALFIERI.

Séance du 29 Octobre 1941

Présidence de S.E. FOUAD ABAZA Pacha

Nécrologie :

Le Secrétaire Général a le regret de faire part du décès de RAGHEB ABDEL MALEK, qui s'est éteint prématurément le 26 Avril écoulé. Cet estimé collègue était membre de notre Société depuis de longues années. Il occupait, avant sa disparition, les fonctions de chef de la section d'entomologie du Musée agricole FOUAD I[er].

Donations :

Les donations qui suivent ont été reçues par la Société :

L.Eg. 50 de la SOCIÉTÉ ROYALE D'AGRICULTURE.

L.Eg. 25 de l'IMPERIAL CHEMICAL INDUSTRIES (Egypte) S.A.

L.Eg. 25 de la SOCIÉTÉ GÉNÉRALE DES SUCRERIES ET DE LA RAFFINERIE D'EGYPTE.

L.Eg. 15 de la SOCIÉTÉ FINANCIÈRE ET INDUSTRIELLE D'EGYPTE.

Le Conseil remercie Son Altesse le Prince OMAR TOUSSOUN, Président, et Son Excellence FOUAD ABAZA Pacha, Directeur Général de la Société Royale d'Agriculture, Monsieur STENER VOGT, Directeur de l'Imperial Chemical Industries, Monsieur H. NAUS, Directeur Général de la Société Générale des Sucreries et de la Raffinerie d'Egypte, Monsieur ESHAK MOHAMED, Directeur Général, ainsi que Monsieur le Docteur MOHAMED SHAFIK, Directeur Technique de la Société Financière et Industrielle d'Egypte pour leur généreuse contribution au développement de notre Société.

Contribution aux collections d'ornithologie :

Monsieur le Professeur H. C. EFFLATOUN Bey a rapporté du Sinaï trois spécimens vivants d'*Alectoris graeca sinaica* Bon. ou « perdrix choukar ». Cette forme n'était pas représentée dans nos collections et nous sommes particulièrement heureux de l'avoir reçue de notre collègue H. C. EFFLATOUN Bey.

Le Conseil remercie le généreux donateur.

Assemblée Générale Ordinaire du 26 Mars 1941

Présidence de Monsieur le Professeur H. C. EFFLATOUN Bey, *Vice-Président*

Rapport du Secrétaire Général (exercice 1940) :

Messieurs,

En présence de la situation difficile actuelle, la Société Fouad 1er d'Entomologie a manifesté une fois de plus sa vitalité en ne changeant rien à sa marche régulière.

Rappelons, tout d'abord, la satisfaction que nous a causé le décret royal. du 19 Février 1940, nommant Son Excellence Mahmoud Tewfik Hifnaoui Bey Président de la Société.

Dès son entrée en fonctions, votre nouveau président n'a ménagé aucun effort pour améliorer notre situation financière. A la suite des démarches faites par Son Excellence, nous avons reçu les donations suivantes :

L.Eg. 50 de la Société Royale d'Agriculture,

L.Eg. 25 de l'Imperial Chemical Industries (Egypt), S.A.,

L.Eg. 25 de la Société Générale des Sucreries et de la Raffinerie d'Egypte.

Nous renouvelons ici nos sentiments de vive gratitude à Son Altesse le Prince Omar Toussoun, président de la Société Royale d'Agriculture, à son directeur général Son Excellence Fouad Abaza Pacha, à Monsieur Stener Vogt, directeur de l'Imperial Chemical Industries, et à Monsieur H. Naus, directeur de la Société Générale des Sucreries et de la Raffinerie d'Egypte, et les remercions pour leur généreuse contribution.

Votre Conseil a institué un comité chargé d'élaborer un programme susceptible de développer les rapports existant entre les membres de la Société. Les recommandations suivantes, présentées par ce Comité, ont été approuvées par votre Conseil :

1°) Les travaux destinés à être publiés dans les Bulletins ou dans les Mémoires de la Société constituent des sujets trop scientifiques pour en faire l'objet de réunions publiques.

2°) De limiter ces réunions à des conférences d'intérêt général, à des causeries ou échanges de vues entre membres sur les problèmes entomologiques qui pourraient les intéresser.

3°) Qu'il soit fait, sous la direction de personnes expérimentées, des excursions entomologiques aux époques favorables.

4°) Qu'un thé annuel soit donné le 28 Janvier de chaque année pour commémorer l'inauguration du Siège de la Société par feu le Roi Fouad I^{er}.

Nous faisons donc appel à votre concours et à vos initiatives afin que ce projet soit réalisé et poursuivi dans l'intérêt général.

Aux nombreux techniciens et étudiants des différentes facultés qui ont régulièrement fréquenté nos salles, il y a lieu d'ajouter les visites quotidiennes du public et celles des établissements scolaires.

Au début de l'année, vous avez reçu le vingt-troisième volume de notre Bulletin, composé de plus de 400 pages, contenant 24 travaux originaux illustrés de très nombreuses gravures et de 3 planches en couleurs.

Le nombre de nos membres et adhérents de toutes catégories est stationnaire.

Quelques dons ont augmenté le chiffre des ouvrages reçus par voie d'échange et destinés à la Bibliothèque. Le dernier enregistré porte le numéro 13316.

Nous avons reçu du Ministère de l'Agriculture un chèque de L.Eg. 397 à titre de subvention pour l'année 1940. Que Son Excellence le Ministre de l'Agriculture veuille bien accepter nos plus vifs remerciements.

Le contrat de votre conservateur a été renouvelé pour une nouvelle période de trois ans.

Votre trésorier a établi le Bilan des Comptes de l'Exercice dûment approuvé par vos Censeurs.

Aux termes de l'article 13 des statuts le Conseil est annuellement renouvelé par tiers. Les membres sortants cette année sont les suivants : Messieurs le Professeur H. C. Efflatoun Bey, le Professeur Docteur Kamel Mansour, le Docteur Saadallah Mohamed Madwar, A. Alfieri. Ils sont rééligibles.

Vous aurez également a désigner le remplaçant de Monsieur le Professeur Docteur H. Priesner et à élire deux Censeurs.

En terminant, nous dédions nos respectueuses pensées à notre Auguste Souverain, Sa Majesté le Roi Farouk I^{er}, et Lui exprimons nos sentiments de profonde dévotion et nos vœux les plus fervents.

Signé : A. ALFIERI

Rapport du Trésorier :

Situation au 31 Décembre 1940

Doit | **Avoir**

Doit	L.E.	MM.	Avoir	L.E.	MM.
Compte Bâtiment (pour mémoire)	1	000	Compte Réserve Générale	15519	415
» Mobilier »	1	000	» Subvention du Gouvernement.............	397	595
» Bibliothèque »	1	000	» Donations	100	000
» Collections »	1	000	» Coupons	704	667
» Laboratoire »	1	000	» Intérêts..............	25	822
» Portefeuille	13535	913	» Cotisations	61	985
» National Bank of Egypt.	1939	666	» Diplômes	1	200
» Cie du Gaz	4	629			
» Appointements........	819	000			
» Publications	346	607			
» Frais Généraux et Entretien	117	967			
» Impôts et Assurances..	41	902			
	16810	684		16810	684

Inventaire

Actif | **Passif**

Actif	L.E.	MM.	Passif	L.E.	MM.
Bâtiment (pour mémoire)	1	000	Réserve Générale............	15485	208
Mobilier »	1	000			
Bibliothèque »	1	000			
Collections »	1	000			
Laboratoire »	1	000			
Portefeuille	13535	913			
National Bank of Egypt	1939	666			
Cie du Gaz..................	4	629			
	15485	208		15485	208

Le Portefeuille Titres en dépôt à la National Bank of Egypt se décompose comme suit :

145 Obligations Héliopolis 5 %.
9020 £ Dette Unifiée Egyptienne 4 %.
6700 £ Dette Privilégiée Egyptienne 3 ½ %.

Signé : R. WILKINSON

Rapport des Censeurs :

En exécution du mandat que vous avez bien voulu nous confier, nous avons l'honneur de porter à votre connaissance que nous avons vérifié les Comptes de la Société Fouad I[er] d'Entomologie pour l année finissant le 31 Décembre 1940 avec les régistres et documents y relatifs.

Nous certifions que le Bilan reflète d'une façon exacte et sincère la situation de la Société telle qu'elle ressort des registres et des explications qui nous ont été données.

Signé : Dr. A. AZADIAN et E. KAOURK

Prévisions Budgétaires pour l'année 1941 :

Recettes	L.E	MM.	**Dépenses**	L.E.	MM.
Subvention du Gouvernement Egyptien	400	000	Publications	200	000
Donations	100	000	Appointements	819	000
Coupons	704	000	Frais Généraux	150	000
Cotisations	60	000	Impôts	36	000
Intérêts	25	000	Assurances	26	000
Vente Publications	5	000	Abonnements Bibliothèque	5	000
			Entretien	15	000
			Imprévus	43	000
	1294	000		1294	000

Signé : R. WILKINSON

Décisions

1° L'Assemblée Générale Ordinaire approuve les Rapports du Secrétaire Général, du Trésorier et des Censeurs et donne décharge au Conseil de sa gestion pour l'exercice 1940.

2° Sur la proposition de Messieurs le Docteur Hamed Seleem Soliman et Hugh Miller (délégué de l'Imperial Chemical Industries), l'Assemblée adopte une motion de remerciements en faveur des Membres du Conseil, du Secrétaire Général et du Trésorier, pour leur excellente gestion de la Société durant l'exercice écoulé.

Elections :

Messieurs le Professeur H. C. EFFLATOUN Bey, Professeur Docteur KAMEL MANSOUR et ANASTASE ALFIERI, membres du Conseil sortants, sont réélus.

Monsieur EDGARD CHAKOUR est élu en remplacement de Monsieur le Professeur H. PRIESNER.

Messieurs le Docteur A. AZADIAN et E. KAOURK sont réélus aux fonctions de Censeurs des Comptes de la Société.

Studies in the structure of *Microbracon hebetor* Say

[Hymenoptera : Braconidae]

(with 6 Text-Figures and Plates I-XVII)

by Prof. Dr. HAMID SELEEM SOLIMAN,
H. Agric. Dipl. (Egypt), A.R.C.S., D.I.C., Ph. D. (Cantab.),
Fellow Fouad I[st] Ent. Soc. (Cairo), F.R.E.S. (London),
Professor and Head of the Entomological Department,
Faculty of Agriculture, Fouad I[st] University, Giza.

CONTENTS

I. INTRODUCTION

This work has been attempted with a view of elucidating some of the important points in the morphology of a Braconid-Type. It is a continuation of a previous work on the biology of the same insect published by the author in this Bulletin (Vol. XXIV, 1940, pp. 215-247).

II. TECHNIQUE

In studying the larval tracheal system Berlese solution and glycerine whole mounts were invaluable.

In fixing the adult, it was found necessary to decapitate it or to cut the body in two at the propodium. Fixing under vacuum gave more satisfactory results. Freshly prepared carnoy, for two hours and a half, at room tempe-

rature, and Bouin's fluid at 60° C. for one hour gave good results. Clearing was best carried out in cedar wood oil, and then the material was slowly graded from cedar wood oil into paraffin wax of 60° C. melting point. The celloidin and wax embedding method was tried; but it was found more satisfactory to fix just when the insect emerged before the chitin hardened and to embed only in wax. The following stains were satisfactorily used : (1) Delafield's haematoxylon and eosin, (2) Mann's staining fluid, (3) Heidenhain's iron alum haematoxylon, (4) Mayer's haemalum, (5) Mallory's phosphomolybdic triple stain, and (6) Aniline blue in picric.

All figures, unless otherwise stated, are camera lucida drawings.

III. The EGG

The egg (Plate I, fig. 2) is tiny, pearly white in colour, opalescent, and sausage shaped , with the two ends rounded but one slightly more acute than the other. One side is slightly convex, the other somewhat concave; there is no stalk, no pattern whatever on the outer surface of the chorion. The average length of the egg is 0.584 mm. and the average diameter is 0.152 mm. When development starts, the egg turns transparent except the area occupied by the embryo, this area appears tranlucent.

IV. The LARVA

There are three ecdysis during the larval life history. The first takes place quite early when the larva is about 0.650 mm. in length, the second soon after, and the third when it is about 1.060 mm.. Thus there are four larval instars.

First instar

When first hatched, the larva is a tiny creature about 0.530 mm. in length, 0.120 mm. in diameter, snowy white in colour and nearly transparent, with the yellowish alimentary canal running through its length. The segmentation of the body is sharply defined. There is a head and a trunk of thirteen segments, the body tapering posteriorly to a point. The head is comparatively big, nearly one-fifth of the whole length of the insect (Plate I, fig. 3) ; it bears two short dorsal antennae, and has the mouth-parts on the ventral side.

Second instar

The second instar, generally, does not differ very much from the first instar except in size and in the number of the mandibular teeth.

Third instar

At the end of the second stage the colour of the larva begins to show itself. In the third stage the larva is no longer transparent, but is generally pearly white. The colour changes according to the colour of the particular region of the host on which the parasite larva has been feeding. A larva which draws its food from, or near, the gonads of an *Ephestia kühniella* Z. caterpillar, is pink or reddish because the gonads of the *Ephestia kühniella* Z. (male) are dark red. Sometimes the parasitic larva is greenish, after a green tinge in the colour of the host.

This instar is cylindrical in shape, tapering towards both ends. The proportion of the head compared to the trunk is very much smaller than what it was during the first stage. The head is no longer prominent as it used to be in the first and second instars. The body is clothed with small spines, which, together with the integumental secretion and protuberances, probably helps in keeping the parasite adhering to its host. Rows of sensory hairs which are longer than the spines are also found segmentally arranged over the whole body. The segmentation is no longer sharply defined as it was in the previous stage. White urate cells can be distinctly seen through the integument. The mid-gut now has grown to occupy most of the body cavity.

Fourth instar

The colour of this instar (Plate I, fig. 4) remains the same as that of the previous one. The form of the body becomes arched, with marked protuberances. The head becomes slightly telescoped into the prothorax and the spines and sensory hairs become more prominent. The mid-gut now fills almost all the body cavity, the salivary glands are well developed, and the tracheal system more branched than was the case in the previous stages. The spiracles can, with care, be detected at the bottom of tiny dimples. At the end of this stage the larva is about 3.0 to 3.2 mm.

The mouth, a transverse slit on the ventral side of the head (Plate II, fig. 10), has its full complement of mouth-parts, and is surrounded and supported by a well developed chitinous ring. On each side this ring is held by two chitinous branches, one of which starts at the basis of the mandible, the other between the maxilla and the labium. These two branches run nearly parallel for a short distance, and then meet to form a powerful strut which runs in the lateral side of the head (Plate II, fig. 10).

The labium overhanging the mouth is short and broad with six sensory hairs near its anterior margin and two towards its posterior. The mandibles lie across the mouth with their bases attached to the chitinous ring. They

have a large tooth and a comb of several dentines and they are best seen in a specimen treated with caustic potash. The maxilla is an inconspicuous protuberance with two sensory hairs at the base and a papilla towards its tip. Each maxilla lies on one side of the mouth, between the two incomplete axes of the chitinous ring with its base fixed on the ring itself. Its tip is free and borders one corner of the mouth. The labium is bounded by a crescent-shaped chitinous support, its tip is irregular and forms the ventral border of the mouth. Near its posterior end there are four sensory hairs, and at about its middle there are two papillae exactly similar to those on the maxilla. Anteriorly the labium bears the opening of the salivary glands. It might be mentioned here that the mouth parts differ in different larval instars.

Alimentary canal

The mouth opens into a short funnel-shaped pharynx (Plate II, fig. 13) with the cells of the dorsal wall comparatively high, while those of the ventral wall are normal. It is provided with a prowerful muscular system which enables it to carry out its pumping function. The pharynx leads into the oesophagus which is a short tube opening into the mid-gut by means of a valve (Plate II, fig. 13). Throughout its length the fore-gut (pharynx and oesophagus) is lined with cuticular intima which is continuous with the external cuticle covering the head (Plate II, fig. 13).

The mid-gut or mesenteron is a large pouch which begins in the second thoracic segment and ends in the eighth abdominal. These limits can best be seen in the very early stages of the larva when this pouch is not so dilated with food. In the later stages the mid-gut almost fills the whole of the body (Plate II, fig. 11).

The mid-gut is followed by the hind-gut which is short and dilated anteriorly into a sort of ampulla. It then opens into the anus by a narrow canal, the cells of whose walls are long and narrow (Plate II, fig. 12).

The malpighian tubules are two in number and begin where the mid- and hind-gut meet. They stretch forwards running under and beside the alimentary canal.

The salivary glands are very well developed and run on both sides of the gut through the whole length of the body (Plate II, fig. 11). In fact, they are much longer than the body of the larva and are twisted into several regular convolutions. The two branches on each side unite in the thorax, the duct formed, meeting the corresponding duct of the other side beneath the alimentary canal. This single median duct then opens in the labium, just behind the mouth.

Respiratory system

There are nine spiracles on each side, arranged in a row parallel to the longitudinal axis of the body, and situated in a nearly dorso-lateral position. The first and most anterior pair lies in the posterior part of the prothorax (Plate I, fig. 4; Plate II, fig. 8). The other eight pairs of spiracles lie in the first eight abdominal segments, a pair in each segment. In the metathorax there is a well developed spiracular trunk but the spiracle is closed and the spiracular branch is missing

All spiracles are of the same size and shape. Each is a minute round aperture, devoid of lips, closing apparatus, and with no external hairs around the opening. The spiracles are connected to the tracheal trunks by short narrow branches, the spiracular branches.

The tracheal system consists of a longitudinal trunk on each side of the body, lying nearly midway between the dorsal and ventral lines. These two trunks are connected anteriorly by a dorsal arch which lies in the front region of the prothorax. Posteriorly, the two trunks are united by a connection situated in the ninth abdominal segment, and which passes ventral to the hind-gut. In front of the anterior dorsal arch each trunk gives off two branches which go to, and ramify in, the head aerating all its parts. The ventral connection of the two trunks which lies in the ninth abdominal segment gives off a ventral branch which ramifies posteriorly (Plate II, figs. 8 and 9).

Each lateral trunk gives off ten simple secondary dorsal branches and ten secondary ventral branches, two of which are simple and eight bifid. The two simple ventral branches lie in the thorax, the eight bifid lie segmentally arranged in the first eight abdominal segments. Each dorsal branch originates in the anterior part of its segment, the ventral having its origin a little further behind in the corresponding segment, except in the case of the most anterior secondaries where the dorsal branch originates behind the ventral. Each of the eight bifid ventrals in the abdominal segments has two branches. One, the anterior, ramifies into many small branches, the other, which is thicker, meets the corresponding opposite branch ventral to the nerve chord. The dorsals are not a thick as the ventrals and form many more finer tracheoles which aerate the whole dorsal and dorso-lateral parts of the body.

The tracheal system does not differ in the different instars of the larva.

V. The COCOON

The cocoon (Fig. 1) is snow-white in colour but exposure to dust causes it to become dirty white. It is about 4 to 5 mm. long and 1 to 1.5 mm. in diameter, and is very strongly but loosely interwoven and difficult to cut.

If it is spun on a smooth surface like glass the side next to the glass is left uncovered. Thus the observer can clearly see the development through the glass. The cocoon is usually formed in a place well away from the remains

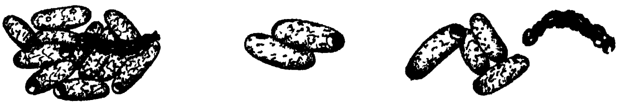


Fig. 1. — Cocoons and their position relative to remnant of host. — × 2.

of the host, a number of larvae spinning their cocoons close to each other and covering them with a loose common web of the same material. In many cases, however, the coocons are solitary and in some cases they may be formed in company with others but with the common covering web absent.

VI. The PREPUPA

The time of transformation of the larva into prepupa is well marked by a black mass accumulating at one end of the cocoon just behind the posterior end of the insect (Plate I, fig. 5). This black mass is the faeces and cast skin of the last larval instar. The prepupa is of the same colour as the larva, its length being about 2.4 to 3.0 mm. The head and thoracic segments are well developed, and, for the first time, the waist of the future adult becomes apparent. The eyes also appear at this stage and can be seen through the prepupal skin.

VII. The PUPA

The pupa is 2.78 mm. in length, and emerges with all its organs compactly arranged (Plate I, fig. 6). The skin of the prepupa is cast away and left in the cocoon at the posterior end near the above mentioned black refuse. The head is well developed and carries the three ocelli, the two compound eyes, the antennae, and the mouth parts.

The antennae are kept straight, ventral to face and body, in their cuticular cases. In the female they do not extend behind the waist. In the male they reach half-way along the abdomen, their joints are clearly marked.

The mouth parts are complete and arranged round the mouth on the ventral side. The maxillary palpi are comparatively long and five-segmented, the labial palpi being short and three-segmented.

Each of the wings is folded on itself in its case and all are folded down to the sides of the pupa. They do not extend further back than the second abdominal segment.

The legs are completely developed and neatly folded ventrally along the sides of the pupa, the hind pair not extending behind the sixth abdominal sternite.

The genital armature in males is completely developed, but not yet scleritised. In the female the stylet and stylet-sheath are partly folded ventrally to the body, their ends together with the sting palpi are curved over.

VIII. The ADULT

General appearance

The adult (Plate I, fig. 7) has an average length of 3.0 to 3.5 mm. and has a wing expanse of about 6 mm. The general colour as seen with the naked eye is dark brown, the ventral side of the abdomen being dirty white The antennae in both sexes as well as the palpi of the female's ovipositor are much darker, whilst the compound eyes and ocelli are black. Under the binocular microscope, the ground colour of the insect is testaceous with very dark patches on certain sclerites. The body is clothed with scattered yellowish hairs, and the wings are dark and iridescent. The legs are testaceous with the middle and hind coxae, the basal joint of the trocanter and the basis of the femur dark brown.

Head and appendages (1)

Head capsule

The head is free from the thorax and is extremely mobile. Mouth is ventral. Viewed from its frontal and posterior aspects, the head is subtriangular in outline (Plate III, figs. 14 and 15), at the dorsal basis of the «triangle» the three ocelli are situated, one median, and two lateral. At the sides of the triangle are the two large oval compound eyes. Ventral to the occipital foramen, the head capsule is excavated into a concavity in which the proximal ends of the mouth parts are lodged (Plate III, fig. 15). Viewed from its lateral aspect, the head is oblong, with a concavity ventral to the clypeus (Plate XII, fig. 88).

The head, like the rest of the body, is covered with testaceous «hairs».

In this specialised head capsule the sutures between the different head sclerites, which are present in more generalised insects, have larvely disappeared. The only sutures which can be detected are: (1) the labro-clypeal suture, (2) the clypeo-frontal suture and (3) the gular sutures.

(1) Through all this paper the description applies both to male and female unless otherwise stated.

The clypeus (Plate III, fig. 14 *cly;* Plate XII, fig. 83) is a narrow slightly arched sclerite at the sides of which are situated the two tentorial pits (Plate III, fig. 14 *tnp*) which are relatively prominent.

The gula is a slightly scleritised plate situated to the ventral region of the occipital foramen (Plate IV, fig. 27 *gu*). It projects anteriorly into the head cavity (Plate XII, fig. 83 *gu*) to receive the proximal ends of the maxillary cardine (Plate IV, fig. 27). At its lateral sides are two short gular sutures (Plate IV, fig. 27 *gus*).

Tentorium

All apodemes constituting a generalised tentorium are represented in the head of *Microbracon hebetor* Say though to a varying degree of development. The anterior arms (Plate III, figs. 20 and 21 *tna*) form the main parts and extend into the head cavity from the anterior tentorial pits to the occipital foramen in an almost horizontal direction. Their inner and outer sides expand in the region of their middle third to form faintly scleritised expansions or narrow lamellae which help to support the brain. A short distance posterior to its middle, each anterior arm gives attachment to a tentorial dorsal arm (Plate III, figs. 20 and 21 *tnd*), which is slender, and which arises on the ocular sclerite from the anterior side of the eye (Plate III, fig. 21). The dorsal arm is absent in *Apis mellifica* L. (Snodgrass, 1925), Near its posterior end, each anterior arm has a process (Plate III, fig. 20 *p*) which gives attachment to some of the maxillary muscles. The body of the tentorium is a narrow median band forming a bridge across the occipital foramen (Plate III, fig. 20 *tnb*). Posterior to the body of the tentorium are two very short posterior arms (Plate III, fig. 20 *tnpa* and fig. 21 *tnpa*), one on each side of the occipital foramen. The tentorial pits of the posterior arms are missing.

Antennae

The antennae are filiform, and are attached to the head near the centre of the face close to the median line of the frons (Plate III, fig. 14). Each antenna fits into a socket which has a well developed chitinous rim sometimes called the antennal sclerite (Plate V, fig. 33 *ansc*). On the lateral lower angle of this rim, there is a chitinous peg (Plate V, fig. 33 *chp*) which projects from the inside level of the rim into the socket, and which is pivoted to the base of a short radicle (Plate V, fig. 33 *rd*). This radicle is membranously attached to the rim of the socket, and is not generally counted by Braconid systematists as an antennal segment (Marshall, 1885).

Each antenna can be differentiated into a proximal and a distal part,

separated by a testaceous coloured zone (Plate V, fig. 29 *tcz*). The proximal part is composed of the radicle, the scape (Plate V, fig. 29 *sc*) — which is the largest segment of the antenna — and the pedicel (Plate V, fig. 29 *pd*). The distal part is the flagellum, and shows sexual dimorphism in the number of its segments, and hence in its length (Plate V, fig. 29). In the male the number of flagellar segments varies from 17 to 21; in the female there are 12 and rarely 13 segments. Of all the British specimens examined by the writer (2), no female possessed more than 13 flagellar segments, whereas 40 specimens from Berlin, all possessed 15-segmented flagellum (3). This variation in the number of flagellar segments bears a direct relation to the size of the insect (Schlottke, 1926).

In both sexes, the flagellum is often the seat of deformation and teratology of different characters. Plate V, figure 37, shows a case repeatedly encountered. Not infrequently, in the same insect, one flagellum has a segment more than the other.

The antenna, as a whole, is moved by means of muscles which have their origin on the dorsal and anterior arms of the tentorium (Plate V, fig. 31, *tna*) and which are inserted on a short tendon attached to the membrane between the radicle (Plate V, fig. 31 *rd*) and the chitinous rim (Plate V, fig. 31 *ansc*). In *Apis mellifica* L. the corresponding muscles are inserted on the basal knob of the antennae (Snodgrass, 1925). The flagellum is separately moved by means of longitudinal muscles having their origin on the consequently well developed scape, and their insertion on the proximal and of the pedicel. Another movement can be detected in the flagellum, mostly in its distal end. This movement varies from a simple curvature to a definite loop, and as there are no muscles or tendons in the flagellum, this movement is not easily accounted for. It might be suggested that it is brought about by blood pressure, or that the basement membrane contains a retractile element which is responsible for the action.

Each antenna is innervated by a double nerve which arises from the antennal lobe of the brain (Plate V, fig. 31 *anl*) and runs through the whole length of the antenna. A tracheal branch (Plate V, fig. 32 *tr*) and a blood vessel (Plate V, fig. 32 *bv*) supply each antenna and run close to, and parallel with, the nerve (Plate V, fig. 32 *nv*).

Johnston's Organ: On the distal end of the pedicel there is a circle of minute pits (Plate III, fig. 16); each pit leads to a group of elongated cells (Plate III, fig. 17) which, together with cells from the adjoining pits, form a cylindrical sheath running in the pedicel and scape. The writer could not

(2) The numbers dealt with were easily over one thousand.
(3) There is no doubt that the species is the same.

trace its joining to the antennal nerve in the scape as described by Child (1894). This organ is Johnston's organ which has been described in many insects, but not in any Braconid before. The pits here are too minute to be seen without cutting sections, and unlike those of most insects, they are not situated on the articulatory membrane, which is here very short (Plate III, fig. 17 *m*) but on the anterior wall of pedicel.

The antennal hair-like or trichoid sensillae are more or less scattered on the scape and pedicel; on the flagellum they are denser and of definite arrangement. Those on the radicle are of smaller size and are denser than those on the scape and pedicel.

A close examination of the antenna reveals an external ribbed appearance to the flagellum (Plate V, figs. 37, 38 and 39). Several clear longitudinal straps traverse each segment and separate darker areas to which the trichoid sensillae are restricted. The clear straps are the rhinaria (Plate V, fig. 38 *rh*) generally found on the antennae of most Parasitic Hymenoptera. The radicle, scape and pedicel are devoid of rhinaria. In *Doryctes gallicus* Reinh. (Braconidae), Seurat (1899) found that the first flagellar segment, as well as the scape and pedicel, is devoid of rhinaria. In the centre of each rhinarium there is a transparent elliptical zone (Plate V, fig. 38 *ez*) which corresponds to the surface area of a placoid sensilla. It seems that the place of the placoid sensilla in the rhinaria is different in different families of Hymenoptera. In *Evaniidae*, *Stephanidae* and *Chalcididae*, the sensilla lies in the basal half of the rhinarium; in *Ichneumonidae*, *Braconidae* and *Cynipidae* it lies in the centre. In *Oryssidae* it occupies the whole area of the rhinarium (Bischoff, 1927; Chrystal, 1930).

There is no difference in shape or size of the rhinaria in the two sexes. The length of the rhinarium varies from 60 to 100 $\mu\mu$. The placoid sensilla (Plate V, fig. 38 *ez*) has a longitudinal diameter of 18 to 20 $\mu\mu$, and a transverse diameter of 9 $\mu\mu$.

In males the rhinaria are evenly distributed around each segment of the flagellum. In females there is a dorso lateral sector (Plate V, fig. 30) on the first flagellar segment which is devoid of rhinaria. In bees and wasps, Vogel (1923) found the same phenomenon, except that the sector which bears no sensillae in females and workers of those two families is not restricted to the first segment, but runs through all the flagellar segments.

The number of rhinaria of the male *Microbracon hebetor* Say is always greater than that of the female as shown on Table I which represents actual counts from cross-sections.

TABLE I

Number of rhinaria on each segment, starting from proximal end

POSITION		TOTAL
	Male	
Left	16, 16, 16, 19, 17, 18, 17, 15, 17, 17, 16, 16, 16, 15, 15, 15, 13, 7	292
Right	16, 16, 15, 17, 17, 18, 17, 15, 16, 16, 16, 14, 18, 15, 15, 14, 11, 2	279
	Female	
Left	3, 7, 12, 14, 16, 17, 20, 18, 17, 16, 16, 15	171
Right	3, 7, 12, 14, 15, 17, 19, 18, 15, 15, 16, 15	166

In females of *Doryctes gallicus* Reinh., Seurat found one rhinarium on the second flagellar segment, three on each of the following 16 segments and five on each of the last 12 segments; he did not give the details of those of the male, but mentioned that they are generally more numerous than in the female. It will be noticed that in both *Doryctes* and *Microbracon* the females have the least number of rhinaria on the proximal end segments of the flagellum, and a greater number is found on the distal end segments. Schulze (1924a) found that *Microbracon* males use the tip of their flagellum to support their body; this might account for the reduction in the number of rhinaria on the terminal segments of the male flagellum noticeable in Table I and shown in Plate V, figure 39.

Structurally the rhinarium is a canaliculus of the flagellar wall sunk under the general level of the cuticle and covered with an extremely thin membrane (Plate V, fig. 32 *m*), not more than 0.4 μμ in thickness. The two edges of the canaliculus are reflexed inwards and prolonged under the membranous cover (Plate V, fig. 32 *c*). At the middle, each caniculus has an elliptical area (Plate V, fig. 38 *ez*) where the chitinous bottom is missing (Plate V, fig. 34), and thus a pore is formed. This pore is the sensory pore through which the internal element of the placoid sensilla pass to communicate with the external cuticular element.

The external ribbed appearance of the flagellum is thus due to the difference in the intensity of light reflected or transmitted from (1) exposed chitin, (2) sunk chitin under the membranous cover. Where the chitin is exposed we get the dark appearance, where it is sunk and covered with membrane we get the clear straps corresponding to the rhinaria. Inside each rhinarium there are two parallel dark linear areas (Plate V, fig. 39 *e*) which give more effect to the ribbed appearance; these are the two reflexed edges of the rhinarium (Plate V, fig. 32 *c*) seen through the membranous cover.

It has been suggested that in the presumed olfactory organs of insects, receptors or processes of sensory cells are bathed, or, at any rate, moistened in a solvent liquid with which the particles of volatile stimuli combined (Berlese, 1909). This conception has not been generally accepted, since no glandular element has been discovered in connection with any of these organs. Furthermore, apart from Erichson's (1847) and Saulcy's (1891) observations, quoted by Berlese, the presence of this liquid has not been noticed. The present writer found that the rhinaria of *Microbracon* contain liquid. As to the source of this liquid, no exact suggestion can be made at this stage.

The hair-like or trichoid sensilla has a membranous cell, a chitogenous cell and a bipolar sense cell. All three cells lie within the ectoderm (Plate V, fig. 36 *tsn*).

The placoid sensilla has numerous sense cells with nuclei rich in chromatin (Plate V, fig. 36). In cross-section of a late pupal stage (just before casting the pupal skin), these sense cells are grouped round a vacule (Plate V, fig. 34 *vc*) opposite the sensory pore, and send out processes which meet in the vacule to form a terminal strand (Plate V, fig. 34 *ts*). This terminal strand ends very near the thin cuticular plate covering the whole rhinaria. Unlike the case in the trichoid sensilla, the sense cells here are subectodermal; they bulge into the body cavity of the antenna carrying with them the basement membrane (Plate V, fig. 36). The nerve fibres at the bases of these sense cells gather together to form a nerve branch (Plate V, fig 36 *nvb*) which joins the antennal double nerve, not in the same flagellar segment in which the sensilla lies, but in the segment proximal to it (Plate V, fig. 36). In sections of adult antenna the sensory cells of neighbouring sensillae of every segment merge together to form one continuous layer beneath the ectoderm (Plate V, fig. 32).

In Plate V, fig. 36, there are two large nuclei on each side of the sensory pore. These might be the nuclei of the chitogenous cells of the placoid sensilla.

According to Bischoff (1927) the placoid sensillae are said to be the only type of sensillae present in the antennae of *Braconidae, Cynipidae,* and *Evaniidae.* Besides the trichoid and placoid sensilla described above, the present writer found a third type on the flagellum of *Microbracon.* Near the edges of the rhinaria, there are some extremely small coeloconic sensillae (Plate V, fig. 35) of the type commonly known as the « shallow pit peg » or « champagne-cork » (Snodgrass, 1927). The nerve running in the core of this sensillae joins the nerve fibres at the bases of sense cells of the same segment.

Mouth parts

The mouth is a transverse opening situated between the movable mouth parts. Its anterior border is formed by the membranous epipharynx strengthened by the labrum (Plate XII, fig. 83). Its posterior border is formed by the hypopharynx backed by the labium. The maxillae and mandibles form the two lateral borders (Plate III, fig. 21). The opening of the salivary duct is outside the mouth and is situated on the labium, ventral to the hypopharynx (Plate IV, fig. 28).

The epipharynx is a non scleritised prolongation of the dorsal wall of the pharynx projecting to the exterior (Plate III, fig. 18 *ep*). It is attached to an inward curved edge of the labrum and bears numerous hairs which serve as protection to the mouth.

The hypopharynx is well developed (Plate IV, fig. 26 *hyp*) and has faintly scleritised edges (Plate IV, fig. 28). As the ephipharynx, it is clothed with hairs to protect the mouth. In *Doryctes*, Seurat (1899) mentions neither an epipharynx nor an hypopharynx.

The labrum is separated from the clypeus by a narrow labro-clypeus suture (Plate XII, fig. 83). It is a concave plate with a curved wide basis and a narrow distal end (Plate IV, fig. 22).

The combined mentum and submentum of the labium form a scleritised boat-shaped trough which carries at its lateral sides the three-segmented palps (Plate IV, fig. 26); inside this structure the labial muscles extend. The glossa is single-lobed having on its dorsal and lateral sides numerous small protuberances arranged in rows (Plate IV, fig. 28). These protuberances have minute prolongations and, no doubt, help in holding the lapped liquid while it is conveyed to the mouth. The paraglossae are poorly developed and consist of two small lobes, one on each side of the glossae. They can be distinguished by two characteristic rows of spines, one on each paraglossa (Plate IV, fig. 28 *pg*). Near each paraglossa the labium has five sensillae (Plate IV, fig. 28 *sn*).

The cardines of the maxillae proved difficult to find. Their proximal ends articulate with the inwardly projecting distal end of the gula and form with it an acute angle. Each cardo is sub-triangular in shape with an articulate knob at its proximal end (Plate IV, fig. 25). The outer edge of the cardo is thickly scleritised into a ridge. The stypes (Plate IV, fig. 24 *st*) are well scleritised at their bases, and laterally they carry the five-segmented maxillary palps. The galea (Plate IV, fig. 24 *g*) is well scleritised, with a keel to the outside and encases the membranous lacinea (Plate IV, fig. 24 *l*).

The mandibles are strong and well developed; they are jointed to the head by a narrow membranous joint (Plate III, figs. 14 and 15). Each mandible is bidentated and has the form of a triangular pyramid (Plate IV,

fig. 23). The outer surface is slightly convex and has at its basis a keel which extends for a short distance; at the distal end each mandible bears several sensillae. The adductor muscles are inserted on the inner basis of the mandible and originate at the posterior and dorsal wall of the head; they are fan-like and more developed than the abductors which are inserted on the outer mandibular base, and which originate at the sides and back of the head.

Thorax

The thorax is attached to the head by a flexible neck which is devoid of cervical sclerites The cuticle of the neck, and that of the joint between the propectus and the rest of the thorax (Plate VI, fig. 41), is composed of a relatively thick chitinous layer, the external surface of which is thrown into numerous protuberances. Each protuberance has a minute process at its summit (Plate VIII, fig. 61). This extraordinary modification of the cuticle is found nowhere else in the body wall of this insect. The worker is unaware of any account of a similar modification, which is probably designed to allow a large amount extensibility.

Prothorax

The pronotum (Plate VI, fig. 40 *n1*) is entirely detached from the rest of the prothorax and is solidly connected to the front of the mesothorax. Its lateral edges extend down on both sides and end ventrally between the procoxae and the mesosternum (Plate VI, fig. 41). The pronotum is subdivided by an external depression into a narrow anterior part and a posterior part (Plate VI, figs. 40 and 44). The posterior part is prolonged backwards until it reaches the tegula (Plate VI, fig. 40 *teg*). Snodgrass (1925) suggests that these two divisions are probably the scutum and scutellum.

The propectus carries the anterior pair of legs and is extremely mobile. It consists of the prosternum (Plate VI, fig. 41 *s1*) and of two relatively large pleural plates which curve round and extend ventrally until they almost meet in the median ventral line (Plate VI, fig. 41 *eps;* Plate VII, fig 48). While most authors regard these two plates as the propleural plates, Crampton (1926) and Martin (1916) regard them as cervical sclerites. Dorsolaterally, each of these two plates is traversed by a faint suture which separates a faintly scleritised triangular division (Plate VII, figs. 48 *y* and 49 *y*) from the rest of the plate. This suture has no connection with the articulation of the coxa, and thus cannot be regarded as a pleural suture. On its lateral posterior angle, each pleuron has a slender process (Plate VII, figs. 48 *x* and 49 *x*), which arches medially. The homologies of these two parts

(Plate VII, fig. 48 *x* and *y*, and fig. 49 *x* and *y*) are difficult to ascertain and, for the present, they must be regarded, generally, as integral parts of the propleura.

On its lateral anterior end, each propleural plate has a characteristic small process (Plate VII, figs. 48 *os* and 49 *os*) which extends forward and loosely articulates with the occiput. Snodgrass (1911) refers to this process as the occipital. In *Microbracon hebetor* Say, the posterior end of this process elongates backwards and projects into the body cavity, to give insertion to muscles originating on the profurca (Plate VII, fig. 48). On its ventral surface the occipital process has several sensillae arranged into two groups (Plate VII, fig. 50); similar sensillae are situated on both sides of the occipital foramen (Plate IV, fig. 27 *sn*). In the male the occipital process is shorter and broader than it is in the female; this character is so clear and stable to the extent that by applying it, one can differentiate, with certainty, a male's from a female's prothorax.

The main body of the prosternum is a semi-pentagonally-shaped plate having its two lateral edges curved inwards, and the anterior margin curved outwards (Plate VII, fig. 45). Anteriorly, the prosternum is overlapped by the propleural plates (Plate VI, fig. 41). It bends upwards to form the posterior border of the propectus (Plate VII, fig 49 *s1*). From its two posterior lateral corners, its sends out two arms (Plate VII, figs. 45 *a*, 48 *a* and 49 *a*); each arm bends to articulate with the propleural plate of its side, and thus a circular membranous area is enclosed. The articulation of the anterior coxa (Plate VII, fig. 49 *cxc1*) lies at the anterior part of this membranous area, the propleural plate forming the anterior border of the articulation while the prosternum does not take any part in it.

The prosternum is not divisible into a basisternum and a furcisternum, the motted lines in Plate VII, figure 45 represent the furcal ribs seen through the sternum. The furcal pit (Plate VII, fig. 45 *f1p*) is well marked.

The furca of the prosternum is well developed (Plate VII, figs. 47, 48 and 49). Its stems and arms are prolonged into broad lamellae which are strengthened by fine ribs. The furcal stem stands on the sternum with a V-shaped basis (Plate VII, fig. 47).

Mesothorax

The mesothorax is well developed and constitutes more than two thirds of the size of the alitrunk (Plate VI, fig. 40). This is apparently due to the fact that the mesothorax is the seat of the large indirect wing muscles which serve as elevators and depressors not only to the anterior pair of wings but also to the posterior pair.

The mesonotum is a dome-like structure divided by an inverted V-shaped

suture (Plate VI, fig. 42 *k*) into an anterior scutu-prescutum and a posterior scutellum (Plate VI, fig. 42 *sctl2*). This external suture marks a strong internal notal ridge (Plate XII, fig. 88 *nr*).

The scutu-prescutum is the combined scutum and prescutum which are not differentiated as separate plates in this insect. It bears the anterior notal wing process (Plate VI, fig. 42 *awp*) and the posterior notal wing process (Plate VI, fig. 42 *pwp*). It is traversed by a very faint suture (Plate VI, fig. 42 *h*) which is not marked internally by a corresponding ridge. Along the middle part of this suture, and to the posterior side of it, is a row of fine punctuation (4). Another faint suture starts behind the posterior notal wing process and curves upwards for a short distance and then comes to an end (Plate VI, fig. 42).

The rear margin of the scutellum is deflected into a thick reduplication and its ends are prolonged into the axillary cord (Plate VI, fig. 42 *axc*).

Posterior to the scutellum, the postnotum or phragmanotum lies hidden under the metanotum (Plate VI, fig. 42 *pn2*). It consists of the postscutellum and the posterior phragma of mesonotum. When dissected out it will be seen that it shows signs of incomplete division along its median line (Plate VI, fig. 43). The phragma (Plate VI, fig. 43 *ph2*; Plate XII, fig. 88) is relatively large and extends inwards and backwards into the body cavity to give attachment to the median longitudinal indirect wing muscles.

The anterior phragma of the mesonotum is small and is situated, internally, at the anterior end of the mesonotum (Plate VI, fig. 41 *ph1*).

The mesopleuron is highly specialised. Externally tho pleural suture is not continuous between the coxal articulation and the pleural wing process (Plate VI, fig. 40), a case which adds to the difficulties of determining the different sclerites of the pleuron. However, if we examine the pleuron from the internal side (Plate VII, fig. 52) it will be found that the pleural ridge, corresponding to the pleural suture, is continuous from the coxal articulation to the pleural process (Plate VII, fig. 52 *plp*), altough its dorsal anterior end is not as strong as its ventral posterior part. It thus separates a narrow faintly scleritised epimeron from the rest of the mesopleuron, i.e. episternum. All the three parts labelled *eps2*, *preps* and *z* (Plate VI, figure 40; Plate VII, figure 52) collectively form the episternum.

In the small membranous area under the tegula, and anterior to the pleural wing process there is a basalare or episternal plate [paraptera of Snodgrass] (Plate VI, fig. 40 *apr*), and behind the pleural process there is a pleural or subalare plate (Plate VI, fig. 40 *ppr*).

(4) The dotted lines *q* and *j* (Plate VI, fig. 42), do not represent sutures but show the borders of the areas on which indirect wing muscles are inserted.

There is no distinct mesosternum. The main part of the episternum (Plate VI, fig. 40 *eps2*) and the sternum form one plate, the ventral side of which is here regarded as the sternum because it carries the furca. This ventral part is not divided by any sutures, but along the median longitudinal line there is an infold (Plate VI, fig. 41) which marks the internal longitudinal plate or lamella of the mesofurca (Plate VII, fig. 52 *fpl*). Near the coxae (Plate VI, fig. 41) another two short infolds, which mark the internal basis of the furca, converge to the median line. The three infolds meet at the furcal pit (Plate VII, fig. 46 *fp*). At the anterior end of the median infold (Plate VI, fig. 41) there is another small pit, which is marked internally by a peg. This is no doubt the detached anterior end of the plate *fpl* (Plate VII, fig. 52).

The mesofurca is relatively well developed (Plate VII, figs. 52 and 53). The two arms of the furca are medially bridged with an arch under which the anterior part of the meso-metathoracic nerve centre is situated. Each arm of the furca is connected laterally to a short arm from the pleural ridge (Plate VII, figs. 52 and 53 : pleural arm *pla2*) by a fan-like prolongation. The mesofurca is anteriorly strengthened by a median longitudinal lamella (Plate VII, fig. 52 *fpl*) to which reference has already been made.

Metathorax

The metathorax is very much reduced (Plate VI, figs. 40 and 42). The metanotum is a narrow plate situated posterior to the mesoscutellum. It is divisible into prescutum, scutum and scutellum. Posteriorly it articulates with the anterior border of the large first abdominal tergum (propodeum). The metapleuron consists of two plates separated by an oblique suture. The anterior dorsal plate is less scleritised than the posterior ventral one, and bears the pleural wing process. Both plates articulate with the first abdominal tergum. Anterior to the pleural wing process, there is a small basalare plate The metasternum (Plate VI, fig. 41 *s3*) is a narrow plate notched at its median posterior end, and at its centre is situated the metafurcal pit. The anterior edges of the metasternum are reflexed inwards (Plate VII, fig. 54 *s3*).

The metafurca differs essentially from the mesofurca (compare fig. 53 with fig. 54 in Plate VII). It has no arch, and its lamella is transverse (Plate VII, fig. 54 *fpl*). The metapleural arms (Plate VII, fig. 54 *pla3*) are more developed than the mesothoracic pleural arms.

The first abdominal tergum is solidly articulated to the metathorax, and together with the thorax form the alitrunk. At its posterior border, the first abdominal tergum, which forms the propodeum of this insect, has a

semicircular notch (Plate VI, fig. 41) into which the second abdominal tergum fits and a unique articulation is formed ([5]).

Wings

The anterior pair of wings (Fig. 2) is dark at the bases and hyaline. Each wing is 2.7 mm. long and 1.0 mm. across its widest part. It has a

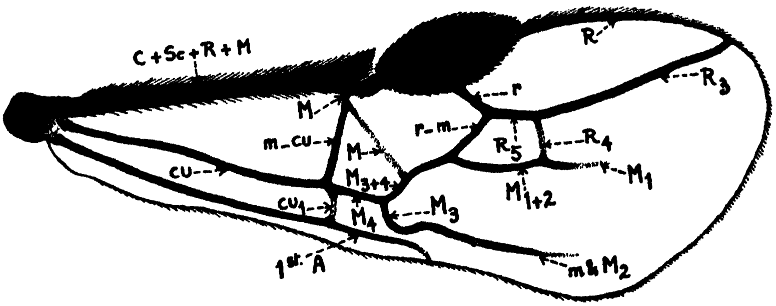


Fig. 2. — Right anterior wing with nomenclature based on Comstock-Needham system.

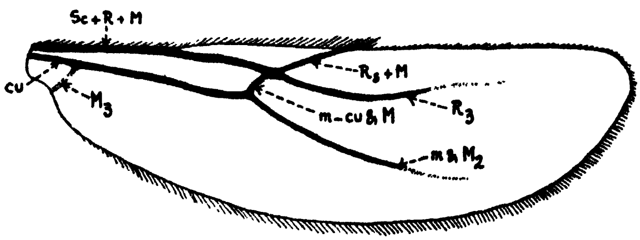


Fig. 3. — Right posterior wing with nomenclature based on Comstock Needham system.

parastigma (Plate VIII, fig. 56 dark area) which bears several sensillae similar to the sensillae on the basis of the wing described by Newton (1931).

Overhanging the anterior side of the wing articulation, is a well developed tegula (Plate VI, fig. 42 *teg*). The articulary sclerites or axillaries are three in number (Plate VIII, fig. 58 *1ax, 2ax* and *3ax*); axillary four is wanting. The first and third axillaries are relatively large, the second is small. Besides the axillaries there are four plates at the basis of the wing. The anterior plate (Plate VIII, fig. 58 *p*) is regarded by some authors as the base of the subcosta on account of its articulation with the first axillary sclerite. The

([5]) Thoracic spiracles are described under « Respiratory system », page 37.

other three plates are the median plates of Snodgrass. Several sensillae of the type so called «olfactory pores» are found on the anterior plate (Plate VIII, fig. 58 *p*) and on the anterior two of the three median plates.

The posterior pair of wings are lighter in colour than the anterior pair. Each wing is 2.0 mm. long and 0.6 mm. across its widest part.

The articulary sclerites are the same as in the anterior wing but,

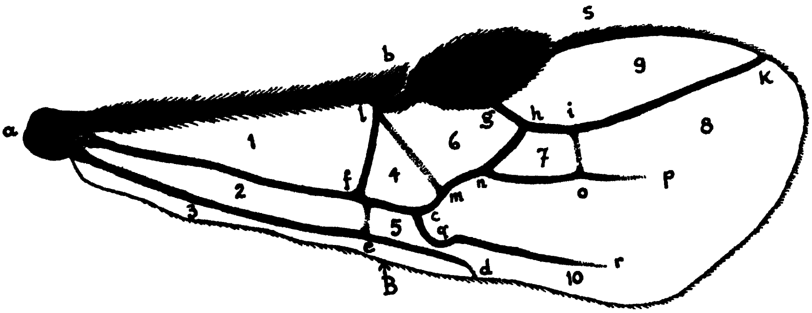


Fig. 4. — Right anterior wing with nomenclature based on Marshall's system for *Braconidae*.

Longitudinal veins: *ab*, costa and subcosta united; *aed*, pobrachial; *afc*, praebrachial; *ghik*, radius [*gh*, first abscissa; *hi*, second abscissa; *ik*, third abscissa]; *lmnop*, cubitus; *qr*, anal; *sk*, metacarpus.

Transverse veins: *hn*, first intercubital; *io*, second intercubital; *cm*, interior discoidal or recurrent; *lf*, praebrachial transverse; *fc*, pobrachial transverse.

Cells (areolets) : 1, praebrachial; 2, pobrachial; 3, axillary; 4, praediscoidal; 5, podiscoidal; 6, first cubital; 7, second cubital; 8, third cubital; 9, radial; 10, anal.

B, rib on which hamuli of posterior wing catch.

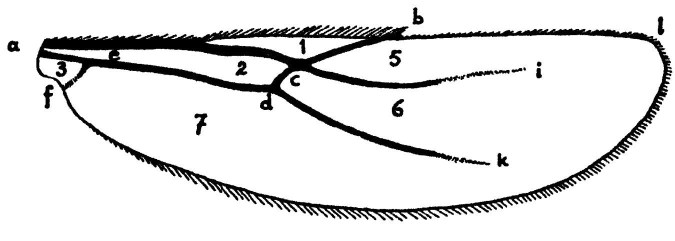


Fig. 5. — Right posterior wing with nomenclature based on Marshall's system for *Braconidae*.

Longitudinal veins: *acb*, subcostal; *aed* praebrachial; *bl*, metacarpus; *ci*, radius; *dk*, cubitus; anal shown in Plate VIII, figure 57.

Transverse veins: *cd*, praebrachial transverse; *ef*, pobrachial transverse.

Cells (areolets) : 1, costal; 2, praebrachial; 3, pobrachial; 5, radial; 6, cubital; 7, discoidal.

of course, they are much smaller. Only two median plates are present in the posterior wing (Plate VIII, fig. 57).

Wing venation : The venation of the anterior wing is of the usual Braconid type. It is interesting to note that the median « M » (Fig. 2) which is missing in *Ichneumonidae* is here conspicuously weak.

In naming the veins in Figures 2 and 3, the worker applies the Comstock-Needham system of nomenclature which is, no doubt, valuable from the morphological view point. But in Hymenoptera, where there is a large amount of coalescence and reduction in venation, the use of the Comstock-Needham system becomes inconvenient and consequently has not been generally adopted. Therefore, the veins are renamed in Figures 4 and 5 according to Marshall's horismology of *Braconidae* (1885).

In the anterior wing (Fig. 4), the second cubital cell is small (smaller than that of *Microbracon brevicornis* Say). The first and second abscissa of the radius are nearly of the same length. The radius attains wing margin near the apex.

In the posterior wing the anal (Plate VIII, fig. 57) is very much reduced and the pobrachial absent altogether (Fig. 5).

Wing coupling apparatus: The wing coupling apparatus consists of three minute hamuli localised at the distal end of the subcostal vein of the posterior wing (Fig. 5) and of a thickened rib at the anal margin of the anterior wing (Fig. 4B).

Wing muscles: The anterior pair of wings has two categories of muscles: (1) Indirect wing muscles, and (2) direct wing muscles.

(1) The indirect wing muscles consist of:

(a) A set of longitudinal muscles on each side of the median dorsal line of the thorax (Plate VIII, fig. 55 *mp*). Anteriorly these muscles are attached to the scutu-prescutum on the area externally bordered by the dotted line « *q* » (Plate VI, fig. 42) Posteriorly, the longitudinal muscles are attached to the posterior mesophragma (Plate XII, fig. 88).

(b) A set of oblique dorso-ventral muscles on each side of the longitudinal muscles (Plate VIII, fig. 55 *idv*). Anterio-dorsally these muscles are attached to the interior lateral side of the scutu-prescutum, on the area externally limited by the edge of the mesonotum and the dotted line « *j* » (Plate VI, fig. 42). Posterio-ventrally the oblique dorso-ventral muscles are attached to the sternum (Plate VIII, fig. 55 *idv*). The indirect wing muscles serve as depressors and elevators to both pair of wings, and are composed of relatively enormous muscle fibres which are dirty white in colour. The area of the scutu-prescutum where the indirect muscles are attached has a dark colour.

(2) The direct wing muscles lie against the inner face of the pleuron arranged in layers one behind the other (Plate VIII, fig. 55 *dm*) ans consist of :

(a) An extensor or pronator set of muscles which lies most interior of all direct muscles and which is the largest of all ; it is inserted on a special disc, the pronator disc (Plate XII, fig. 88 *ap*) ; this disc is connected by a chitinous prolongation to the anterior paraptera or the basalare and is attached to the adjacent part of the episternum.

(b) Two fan-shaped flexor muscles inserted on the third axillary sclerite by means of tendons.

(c) A fan-shaped muscle inserted on the first axillary sclerite by a short tendon.

(d) A comparatively small muscle arising near the pleural arm and inserted on the subalar plate.

The posterior pair of wings possesses no indirect wing muscles, and each has a set of direct wing muscles corresponding to those of the anterior wing (a) (b) and (c). The pronator muscle of the hind wing has no pronator disc and is inserted by tendon on the metabasalare.

Legs

The three pairs of legs differ enormously in length (Plate VIII, fig. 59) and consist of the usual leg segments.

The fore leg has a freer movement than the middle and hind legs. Its coxa is nearly square in shape. The tibial spur and metatarsus are modified to serve as antannae cleaner (Plate IX, fig. 69). The proximal part of metatarsus is curved and fringed with a comb-like row of bristles. The spur is relatively large and flat and is also provided with bristles similar to those on the metatarsus.

During breeding an interesting deformity of the right anterior leg was encountered in a male pupa (Plate VIII, fig. 60 *fg*). That leg was deformed to a sort of stump carrying a segmented ring. However, at its last developmental period the pupa failed to be transformed into adult.

The coxa of the middle is pear-shaped, that of the hind leg is elongated (Plate VIII, fig. 59). Each of the middle and hind coxae has a small meron which carries a characteristic group of 7-8 sensillae (Plate VII, fig. 51).

The two small segments between the coxa and femur have been regarded as the first and second trochanter. The anatomy of this part in *Microbracon hebetor* Say shows that the reductor femoris muscles are inserted on the base of the distal segment, and that the flexor muscles of the tibia are also attached to the same fold. This anatomical fact was observed by Snodgrass (1927) and led him to conclude that the so called second trochanter

in most of the Hymenoptera Parasitica, is morphologically a basal part of the femur.

Praetarsus: The distal segment of the tarsus or the distitartus — as it is sometimes termed by some authors (Crampton, 1923) — carries terminally an organ composed of several parts. Some workers refer to these parts separately, others give the compound structure a collective name. Schiodt termed it the *ungus* or *ungula*, De Meijere (1901) and Arnhart (1923) respectively called it *praetarsus* and *claw segment* (krallenglied). Snodgrass (1927) suggests that this organ « might appropriately be termed *foot* but not with those insects that place a part or all of the tarsus on the supporting surface »; however, he adopts De Meijere's nomenclature simplified to *praetarsus*. Ewing (1928) and Imms (1931) employ this term. MacGillivray (1923) calls this organ *articularis* and objects to the use of the term praetarsus on the grounds that it is « a misnomer at best for the articularis is in reality a post-tarsus ». In the present paper the term *praetarsus* is used as it is now accepted by the majority of entomologists.

In *Microbracon hebetor* Say the praetarsus is the same in all legs and in both males and females. It is of a complicated type, composed generally of two lateral strongly scleritised claws (Plate IX, fig. 62 *cl*), and a median so called adhesive organ, which is a membranous bag supported dorsally and ventrally with chitinised plates and terminating in a soft lobe or arolium which can be folded or out-spread according to use. The cavity of this organ is continuous with the body-cavity of the last tarsal segment, whose end is thickly scleritised to form a connecting edge for the adhesive organ (Plate IX, fig. 62 *ed*).

Claws: Each claw is cleft into a dorsal hook curved downwards and a ventral lobe carrying two sensory hairs. From the basi-dorsal side of the hook arises a prominent bristle which has its basis deeply embedded in the main body of the claw (Plate IX, fig. 62 *br*). The colour of the hook (and that of the claw generally) varies from dark brown to black in insects bred in low temperature but is testaceous in those bred in temperature above 24° C. The main body of each claw is less scleritised than the hook and is clothed with hairs. Each claw has two processes facing the median adhesive organ and embedded in its walls. One of these processes is latero-dorsal, the other is latero-ventral. The claws open into the adhesive organ between these two processes. Plate IX, figure 66 shows the opening of the claws into the adhesive organ, and one of the latero-dorsal processes *ldp*. The section is oblique and does not pass through the latero-ventral process.

Unguifer: The bases of the claws move on the knobbed end of a V-shaped piece (Plate IX, fig. 63 *ung*) which is connected by a short articular membrane

to the dorsal end of the last tarsal segment. This piece corresponds to the « krallenhöker » of Dahl, Ockler and De Meijere, to the « unguifer » of Crampton (1923), and the « tubercula » of MacGillivray (1923). Crampton describes the unguifer as a dorsal process; Snodgrass (1927) defines it as a « median process of the distal end of the last tarsal segment ». In *Microbracon hebetor* Say, this articular piece is not a process of the last tarsal segment, but, as was stated before, a separate piece connected to that segment by a short membrane. MacGillivray terms this piece tubercula and defines it as a projection or emargination against which the claws and orbicula articulate.

Orbicula: Dorsally the adhesive organ has a plate (Plate IX, fig. 63 *orb*) which has been termed the supporting plate (stutzplatte) by both Ockler (1890) and Arnhart (1923), the pressure plate (druckplatte) by Dahl (1884), the protective plate (schutzplatte) by De Meijere (1901) and the orbicula by MacGillivray (1923). Crampton (1923) does not mention it. The proximal end of this plate narrows and curves ventrally and is membranously connected to the unguifer. The distal end of the orbicula lies in a sort of a cavity formed by the folding of the arolium (Plate IX, figs. 63 and 65). The two lateral edges of the orbicula are reflexed ventrally in the manner shown in Plate IX in the two figures 65 and 66. The basis of the orbicula sometimes rests on the two arms of the v-shaped unguifer midway between the apex and the knob articulating with the claws. On its dorsal surface, the orbicula bears four sensory hairs of equal length, characteristically arranged as shown in Plate IX, figure 63, and two comparatively large dome-like or campaniform sensillae (Plate IX, fig. 63 *cs*). The sensory hairs on the orbicula differ in different Hymenopterous families. De Meijere describes two strong hairs or bristles in *Formica*, and two strong and many smaller in both *Bombus* and *Vespa*. In the honey-bee worker, Snodgrass (1925) describes five long hairs arranged in a line across the base of the orbicula and curve over the arolium.

Calcanea: On the ventral wall of the membranous adhesive organ is a comparatively large plate (Plate IX, fig. 62 *cal* and fig. 64 *cal*) called the *extension plate* (streckplatte) by Dahl, Ockler, De Meijere and Arnhart, the *unguitractor* by Crampton and the *calcanea* by MacGillivray. The two latero-ventral sides of this plate are serrated, and at its distal end each side of the plate carries a strong sensory hair (Plate IX, fig. 62). The calcanea is retracted into the last tarsal segment by means of the tarsal-muscle tendon (Plate IX, fig. 62 *tn*) which is attached to the calcaneal proximal end and which is worked by the tibial muscle. In the act of being retracted the calcanea has its ventral surface gliding on the

strongly scleritised infold of the median ventral part of the last tarsal segment which is termed *gleitflache* (Plate IX, fig. 62 *fl*) by De Meijere. When the calcanea is retracted it causes the claws to be reflexed backwards and outwards as they usually are, when not in use.

Distal to the calcanea on the ventral wall of the membranous adhesive organ is a very faintly scleritised area termed the ***planta*** (Plate IX, fig. 62 *pl*). This area is covered with small hairs and in other insects it is usually more scleritised than it is here.

Arolium: The membranous part of the adhesive organ which lies distal to the orbicula and planta is usually termed the arolium (Plate IX, fig. 62 *ar*). It has a narrow scleritised *band* or *bow* (Plate IX, fig. 62 *bw*) which embraces the ventral, lateral and some of the dorsal sides.

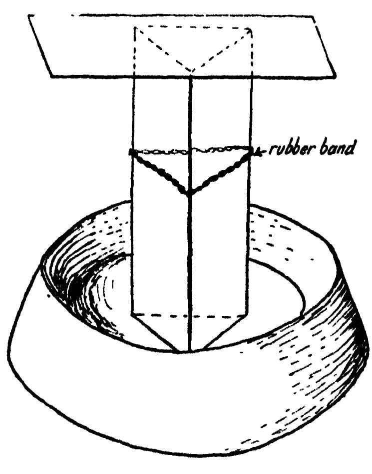


Fig. 6.

In many insects the arolium bears tenent hairs which are very small modified glandular setae responsible for the secretion of adhesive fluid which enables those insects to climb smooth surfaces. The writer could not see these hairs in *Microbracon hebetor* Say, probably they are too small to be seen by the magnification available or they are absent.

When the insect climbs a hard smooth surface, the bow is flattened and the arolium is thus spread open and pressed against the substratum. Plate IX, figure 67 shows the arolium half open. In walking on a smooth flat surface the arolium is used, but in this case it is folded (Plate IX, figs. 62 and 63). In both these cases the claws are reflexed backwards and outwards, and only come in use when the insect is climbing or walking on rough surfaces.

Microbracon hebetor Say can with great ease climb perpendicular smooth

surfaces, and can walk on the lower side of horizontal or slanting glass. The way by which this is accomplished is not clear. The following experiment was carried out.

Four slides were left in alcoholic eosin for 8 hours. After drying, they were microscopically examined. A thin homogeneous film of the stain was deposited on their surfaces. The slides were then arranged as shown in Figure 6. Some adult *Microbracon* were placed inside. The insects freely ascended and descended, they also walked on the under surface of the covering top slide. After a time the slides were subjected to careful high power microscopic examination. No foot prints were found at all. Thus in the absence of any fluid, ascending cannot be due to adhesion or seizure as conclusively shown by Gillett and Wigglesworth (1932) in case of the adult *Rhodnius prolixus* (Hemiptera). The way of descending and walking on the under surface of a horizontal slide in *Microbracon* is, yet, more difficult to understand.

In the following Table II the nomenclature used by different authors for the tarsal parts is tabulated.

Abdomen

General features common to both sexes

The abdomen in both sexes is composed of nine terga and ten sterna; the membranous part anterior to the anus (Plate X, fig. 71; Plate XI, fig. 76) may theoretically be considered as the tenth tergum. Another way of explaining the morphology of this region is to regard the anus as being carried by the tenth segment and that only the sternites of this segment are scleritised and the rest is membranous. In *Doryctes*, Seurat (1899) found that the abdomen is formed of only nine segments and that the last one bears the anus.

The first abdominal tergum is shifted to the thorax (Plate VI, fig. 40 *I*), a normal hymenopterous feature. But it is interesting to note that the first abdominal sternum still lies in the abdomen, a case which differs from most hymenoptera, and which is also found in *Sycosoter lavangei* (Braconidae) (Lichtestein and Picard, 1918), and in *Doryctes gallicus* Reinh. (Braconidae). Marshall (1885), Snodgrass (1909 and 1910) and Fahringer (1928) do not mention anything about this point; and at this stage the present investigator cannot tell if it is a feature common to all *Braconidae* or not. In *Microbracon hebetor* Say this first abdominal sternum is reduced to a narrow scleritised strip, which is broadened at its articulation with the second abdominal tergum (Plate X, fig. 74 *Is*). On this, relatively broad, lateral articulate side the first abdominal sternum carries numerous small sensillae (Plate X, fig. 74 *sn*). It is noteworthy that these particular sensillae

TABLE II

AUTHORS	NOMENCLATURE OF PRAETARSAL PART					
DAHL........	—	krallenhöcker	pressure-plate druckplatte	extension-plate streckplatte	—	chitinous bow chitin-bogen
OCKLER........	—	krallenhöcker	support-plate stützplatte	extension-plate streckplatte	strecksohle	elastic bow elastischer bogen
DE MEIJERE....	praetarsus	gelenhöcker	protective-plate schutzplatte	extension-plate streckplatte	strecksohle	—
ARNHART......	claw segment krallenglied	—	support-plate stützplatte	extension-plate streckplatte	sohle	bow bögel
CRAMPTON	—	tubercula	—	unguitractor	—	—
MACGILLAVRAY.	articularis	unguifer	orbicula	calcanea	planta	camera

occur at the ventral side of the two restrictions of the body. As was already mentioned, they occur on the occipital process (Plate VII, fig. 50) and on the two sides of the occipital foramen (Plate IV, fig. 27 *sn*) ; and here they occur between the alitrunk and the gaster.

All terga are scleritised; the seventh tergum is the last visible one, the eighth and ninth are telescoped into it (Plate X, figs. 70 and 73). The first eight terga bear spiracles (described under respiratory system).

The second abdominal tergum is small and nearly square in shape (Plate X, fig. 72 *II*). It extends only a short distance on either side of the longitudinal median line. It has two arching carinae (Plate X, fig. 72 *k*). This tergum is characteristically divided into areas which, in their relative position, form a parallel to the division of a thoracic notum into prescutum, scutum and scutellum. The area *IIt* (Plate X, fig. 72) is parallel to the prescutum, the area carrying the spiracle is parallel to the scutum and the dark coloured area is parallel to the scutellum. From the systematic view point, this tergum is important and is usually referred to as the first abdominal tergum (not counting the propodeum).

The third abdominal tergum is usually lighter in colour than the rest of the visible terga (Plate X, figs. 70 and 73). Its posterior end lies in juxtaposition with the anterior end of the fourth abdominal tergum without any intersegmental membrane between them ; this character is common to most *Braconidae*.

The abdominal sterna are almost membranous (sterna, one in both sexes, eight and nine in male are excepted). Sterna three to seven, and sternum ten, each carries a pair of scleritised sternites on its lateral borders (Plate X, fig. 70 *stn*, and fig. 73 *stn*). The sternites of the tenth sternum are subcrescentic in shape, and are situated ventral to the anus (Plate XI, fig. 77 *xs*). In *Doryctes* (Seurat, 1899) each of the nine sterna is one continuous scleritised plate, more or less similar in shape to the terga.

The cerci in both sexes are situated in the membranous area posterior to the ninth tergum (Plate XI, fig. 76 *cr*, and fig. 77 *cr*). Each cercus consists of one segment carrying long bristles (Plate XI, fig. 78 *cr*).

Abdomen of female

The size of the abdomen in the female is, generally, slightly larger than that of the male.

The female's eighth tergum is prolonged on both sides of the abdomen (Plate XI, fig. 76 *VIII*). The ninth tergum together with parts of the eighth and ninth sterna are modified to form the genitalia which are described under the reproductive system.

Abdomen of male

The eighth and ninth sterna of the male are the only two completely scleritised sterna in the abdomen; each one of these two sterna forms a narrow continuous plate. The male genital armature is situated between the ninth and tenth abdominal sterna.

In the male, the hypodermal cells underlying the anterior part of the eighth abdominal tergum, are modified to form a compact gland (Plate X, fig. 71 *gl*). This gland extends across the tergum and consists of one layer of columnar epithelial cells with large spherical nuclei (Plate X, fig. 75). The anterior border of the gland is level with the anterior end of the tergum, which has a characteristic transverse thickening, not found in other terga. The present worker was unable to find any ducts or external openings to this gland; furthermore, the part of the tergum overlying the gland is thick and heavily scleritised. These facts suggest that the function of the gland is probably internal. Work is being carried on to find the true function of this gland and at present, there is no use to speculate on this point.

As far as the present worker is aware this gland has not been found or described before. The so-called scent gland on the seventh abdominal tergum in *Apis mellifica* L. is found in the worker and the queen and is missing in the male. James (1926) describes a pair of glands one on each side of the eighth abdominal segment in *Harmolita*, but again these are found in females and are missing in males. In both these two cases the glands have external openings unlike the glands found in *Microbracon hebetor* Say which have no openings. Various unicellular glands have been described in bees and wasps, but these are mostly situated on the ventral abdominal plates and on their inter-segmental membrane.

Alimentary canal

The alimentary canal forms a tube running from the mouth to the anus (Plate XII, figs. 83 and 88); the diameter of this tube differs at different parts. It is longer than the body and, consequently, is bent into loops. The colour of the alimentary canal is white, almost transparent, so that the contents can be seen through the walls of the gut. It is differentiated into fore-gut or stomodeum, hind-gut or proctodeum and mid-gut or ventriculus. The fore and hind guts are internally lined with chitinous intima.

The malpighian tubules open into the alimentary canal at the junction between the mid and hind guts (Plate XIII, fig. 95).

The thoracic or salivary glands have no connection with the alimentary canal and open on the labium under the hypopharynx as was already mentioned.

Fore-Gut

The fore-gut comprises the pharynx, the oesophagus, the crop, and the proventriculus or gizzard (Plate XII, fig. 86 *prv*).

The *pharynx* extends from the mouth to the beginning of the oesophagus (Plate XII, fig. 83). The point of differentiation between the pharynx and the oesophagus is the insertion of the muscles which originate in the frons of the head. The pharynx stands vertically in the head and nearly at right angles to the oesophagus. It has a powerful muscular coat and other muscles arising from the facial wall of the head are inserted on its walls.

Histologically the pharynx consists of an innermost chitinous layer, a layer of epithelial cells resting on a basement membrane and a muscular coat.

A short distance from the mouth the chitinous layer in the floor of the pharynx is scleritised into a strong pharyngeal plate (Plate XIII, fig. 92 *php*), the anterior arms of which rest on the two posterior sides of the hypopharynx. The posterior arms of this plate are comparatively long and curve upwards in the lateral walls of the pharynx. Posteriorly, and on each side of the median line, the pharyngeal plate has seven sensillae (Plate XII, fig. 84 *sn*) which, gathering from their position, and from the thinness of the wall of the dome covering each sensilla are probably gustatory in function. Under the dome of each sensilla is an elongated sense cell in the centre of which there is a receptor (Plate XIII, fig. 93). Each group of seven sensillae is innervated by a nerve which can be traced to the suboesophageal ganglia. The epithelial cells under the plate are columnar and very well developed (Plate XII, fig. 83; Plate XIII, fig. 92). The epithelium in the dorsal wall of the pharynx is a syncytium (Plate XIII, fig. 92).

Just behind the entrance of the mouth the pharynx has six, presumably gustatory sensillae in its dorsal wall under the labrum (Plate IV, fig. 22 *sn*).

The *oesophagus* is very narrow and extends from inside the head to the end of the thorax, and in the abdomen it enlarges into the crop. Leaving the head to the thorax, the oesophagus passes through the partition of the occipital foramen which lies dorsal to the transverse tentorial body.

Structurally the oesophagus is composed of an innermost layer of chitinous intima lining, a syncytial layer which is thrown into folds and which rests on a basement membrane. The muscular coat is composed of an inner longitudinal layer and an outer circular one (Plate XII, fig. 85).

The *crop* is a much dilated prolongation of the oesophagus. Its walls are thrown into numerous folds (Plate XII, figs. 88 and 89) showing its great capacity for extension. The crop lies in the anterior part of the abdomen and its structure is the same as that of the oesophagus, except that its muscles are comparatively poorly developed. At its posterior end the crop

is invaginated by an inpushing of the anterior end of the proventriculus which projects a little distance into the cavity of the crop (Plate XII, fig. 86).

The *proventriculus* is a short narrow region of the gut joining the crop to the ventriculus (Plate XII, fig. 88). Its posterior end projects into the mid-gut forming what is generally known as the cardiac or oesophageal valve (Plate XII, fig. 86; Plate XIV, fig. 100). Wigglesworth (1930) showed that this structure does not act as a valve but as a sphincter and hence, he thinks that, the term « valve » is unfortunate. Into the lumen of the proventriculus project three longitudinal folds, the intima of which is strongly chitinised and provided with denticles (Plate XII, fig. 87). This strong chitinisation is prominent in the anterior half of the proventriculus and is lost posteriorly (Plate XII, fig. 86). Three comparatively very small folds alternate between the prominent ones; their chitinous lining is not thickened. It seems that the number of the prominent folds of the proventriculus is different in different families of Hymenoptera. In both *Apis mellifica* L. (Pavlovsky and Zarin, 1922) and *Vespa vulgaris* L. (Green, 1931) they are four; eight in *Camponotus* (*Formica*) (Wheeler, 1910) and three in *Harmolita* (Chalcidae) (James, 1926).

Structurally the proventriculus is composed of an innermost layer of well developed chitinous intima, outside which is a layer of epithelial cells lying on a basement membrane, followed by a coat of three layers of muscles, an inner longitudinal, a middle circular, and an outer longitudinal. The cells of the epithelial layer are well marked anteriorly but in the posterior part of the proventriculus their limit is very difficult to make out. The layers of the inner longitudinal muscles are well developed in the longitudinal folds (Plate XII, fig. 87) and on the whole are stronger anteriorly than they are posteriorly.

The *cardiac invagination* [6] is short and does not extend far in the mid-gut as it usually does in most other insects. Its inner wall (Plate XIV, fig. 100) is a continuation of the chitinous intima and the epithelial layers of the proventriculus. These two layers are reflexed upwards to form the lower part of the outer wall. The upper part of the outer wall is composed of a syncytium which takes the stain deeply (Mallory's phospho-molybdic triple stain) and which is apparently not a continuation of the proventricular layers. At the bottom of the invagination there is a blood sinus (Plate XIV, fig. 100 *bs*) which when full distends the invagination (Plate XIV, fig. 100) and when empty turns it flabby or collapsed (Plate XII, fig. 86). Just where the invagination dips into the mid-gut there is a layer of sphincter muscles

[6] « Invagination » is used here in place of the word « valve ».

(Plate XIV, fig. 100 *sph*) which in fact is a development from the middle circular muscles of the proventriculus.

The *ventriculus*, mid-intestine, or true stomach is here a cylindrical tube of comparatively wide diameter, beginning at the cardiac invagination and ending at the opening of the malpighian tubules. Externally, it bears very slight annulation which disappears in well fed insects. This annulation is prominent in other insects, and Shinoda (1927) thinks that it is dependent on the amount of food in the stomach.

Histologically the *mid-gut* consists of an enteric epithelium lying upon a basement membrane, outside the latter are an inner circular and an outer longitudinal muscles (Plate XIII, fig. 95).

The *epithelium* is composed of a layer of large cubical cells with round nuclei. Towards the inside, these cells have a well marked striated hem, due to closely set cilia-like structures which stain deeper than the cells in Delafield's, and which stain grey in iron alum haematoxylin. This hem is often seen pealed off or delaminated into the lumen to form the periotrophic membrane, and during the active phase it is, of course, missing. In few instances a globule may be seen as though on point of liberation from the cell into the lumen; Pavlovsky and Zarin (1922) described these globules as artificial.

Very few nidi or regenerating cells, peculiar to adult insects, are found in the mid-gut epithelium of *Microbracon hebetor* Say (Plate XIII, fig. 94).

At the entrance of the mid-gut there are some cells which stain deeply (Plate XIV, fig. 100). It has been shown (Wigglesworth, 1930) that these cells are, in some insects solely, and in others partly, responsible for the secretion of the periotrophic membrane. While it is not absolutely clear whether these cells take any part in the formation of the periotrophic membrane in this insect, and if so, to what extent, it is certain that the delamination of the striated hem plays an important role in the formation of that membrane.

Hind-gut

The hind-gut begins at the opening of the malpighian tubules and ends at the anus (Plate XII, fig. 88). It is about the same length as the mid-gut and, externally, can be differentiated into four regions:

(1) A short region just posterior to the opening of the malpighian tubules; the diameter of this short transitional region is a little less than the posterior end of the mid-gut.

(2) A comparatively long region which is narrower than the first, and ends before the dilation of the rectum.

(3) A much dilated part the diameter of which is the greatest in hind-

gut, this region contains, in its anterior part, the so-called « rectal glands » or pads.

(4) A short narrow passage leading to the anus.

Histologically these four regions though essentially the same, differ in details. The first region is composed of a cuticular intima, an epithelial layer sitting on a basement membrane, outside which are inner circular and outer longitudinal muscles. The cuticular intima and epithelial layers here are not thrown into folds. The epithelial cells are flat with oval nuclei (Plate XIII, fig. 95). Both circular and longitudinal muscles are comparatively well developed. In the second region both the cuticular and epithelial layers are thrown into many folds. The epithelial cells are vestigial and the longitudinal muscles are wanting in this region. In the third region, the epithelial cells are very poorly developed especially where the rectal glands are; the cuticular intima is well developed and both epithelium and intima are thrown into folds in the regions where the glands are absent; longitudinal muscles are wanting and circular are poor. In the fourth region the intima and epithelium are very much thrown into folds resembling those in the oesophagus (Plate XIII, fig. 99), the longitudinal muscles are absent, the circular muscles are very well developed forming a powerful sphincter. This part of the gut is suspended from the dorsal and lateral walls of the body by numerous muscles (Plate XIII, fig. 99).

The *rectal glands* or pads are four in number and are evenly spaced on the walls of the anterior part of the rectum (Plate XIII, fig. 96). In *Apidae* and *Vespidae* they are six in number, in *Formica* they are three (Wheeler, 1910) and in *Harmolita* (Chalcidae) they are only two (James, 1926). In *Microbracon* the glands or pads are not elongated as they are in most other insects, but are cubical. Each pad has an axial cavity (Plate XIII, fig. 97 *axc*), which divides it into an exterior and an interior layer of cells separated laterally by a syncytial which stains deeply (iron alum) (Plate XIII, fig. 97 *syn*). The exterior layer is composed of two rows of small spherical cells which generally stain deeper than the interior. The interior layer is composed of only one row of comparatively very elongated cells with big nuclei poor in chromatin. Invariably these cells of the inner layer have inclusions which stain deeper (Plate XIII, fig. 98 *ci*). Each pad is richly supplied with trachea, branches of which penetrate the exterior layer (Plate XIII, fig. 98) and ramify intercellularly in the inner layer. The inner cutical intima lining the pads is of course continuous on the whole inner surface of the rectum, but on the pads it is more developed. The function of these pads was at first thought to be secretive, but Wigglesworth (1932) suggests that it is absorbtive and that these pads reabsorb water from the excrements before this is discharged, and thus play an important part in water-conservation.

The *malpighian tubules* are twelve to fourteen in number; each tubule opening separately into the gut and all open at one level round the junction of the mid and hind-guts. They are long, filamentous, greenish tubules intermingled together, and coiled about the abdominal viscera (Place XII, fig. 88). In cross-section each shows a single layer of four or five large cubical cells with big round nuclei (Plate XII, fig. 91). This epithelium is internally lined with very thin cuticular intima, and externally bordered on a basement membrane outside which there are no muscles. The lumen is longitudinally irregular (Plate XII, fig. 90). The tubules and the gut are in open communication and where they join (Plate XIII, fig. 95) the longitudinal and circular muscles on the gut and on the neck of the tubules are well developed and probably responsible for the vermiform movement of the tubules. In *Doryctes gallicus* Reinh. (Braconid), Seurat (1899) found only 9 tubules.

Salivary glands

Bordas (1894, 1894a and 1895) described ten different kinds of so called salivary glands in Hymenoptera. Seurat (1899) described two kinds in *Doryctes gallicus* Reinh. (*Braconidae*), the thoracic salivary glands, and another pair of glands which « are like a bunch of grapes and which occupy the posterior dorsal region of the head behind the brain and open in the oesophagus ». He did not figure or describe their exact opening in the oesophagus.

In *Microbracon hebetor* Say, the present investigator was able to find only the thoracic pair of salivary glands. It seems probable that Seurat mistook the masses of fat cells, usually found behind the brain, for salivary glands, a misinterpretation which both Bordas (1895) and Snodgrass (1910) did in the case of the honey-bee; closer inspection, however, made Snodgrass (1925) correct himself.

The two thoracic glands of *Microbracon hebetor* Say are not very well developed and are situated in the anterior part of the mesothorax under the median indirect wing muscles. The two ducts from the glands meet just before entering the head and form one prominent duct which runs under the oesophagus and pharynx and opens at the dorsal side of the labium ventral to the hypopharynx (Plate XII, fig. 83).

Circulatory system

Seurat (1899) does not describe the circulation system of *Doryctes*. In *Microbracon hebetor* Say, the blood has a very faint yellowish tinge and contains few granular leucocytes. There is a dorsal or pericardial diaphragm and a dorsal vessel. No ventral diaphragm was found.

The *dorsal diaphragm* extends from the anterior region of the seventh

to the anterior part of the third abdominal tergum, separating a dorsal or pericardial sinus from the rest of the haemocoele. Radiating in the diaphragm are five pairs of alary muscles each of which converge to a small area of attachment on the tergum. Medially, fine fibres from branches of these muscles are attached to the ventral side of the heart (Plate XIV, fig. 106 *fb*). Comparatively few of these fibres extend under the heart.

The *dorsal vessel* extends from the anterior region of the seventh abdominal tergum to the head, where it bifurcates just under the deutocerebrum, giving off a branch to each antenna.

In the abdomen, the dorsal vessel is situated in the pericardial sinus, just under the integument, from which it is suspended by several suspensoria (Plate XIV, fig. 106 *us*). These suspensoria are exactly similar to the fine fibres of the alary muscles attached to the ventral side of the heart. In the second abdominal segment, the dorsal vessel dips down and becomes twisted into three or four convolutions before entering the alitrunk. In the alitrunck it is very much narrower in calibre and runs dorsal to the alimentary canal and ventral to the median indirect muscles (Plate VIII, fig. 55 *ao*). It enters the head through the dorsal partition of the occipital foramen. The part of the dorsal vessel extending from the seventh to the second abdominal terga is the pulsating organ or heart. The remaining part of the dorsal vessel beginning after the convolutions is the conducting part or aorta.

The heart is composed of five chambers, in each chamber there is a pair of ostia. At each ostia, the walls of the heart are prolonged inwards and forwards into the lumen forming the valves. The ostia and valves are best seen if a testaceous living specimen of *Microbracon hebetor* Say is mounted in normal saline solution and one of the heart chambers is watched under high magnification with the help of a powerful transmitted « pointolite ».

On either side of the heart are situated the dorsal nephrocytes or pericardial cells (Plate XIV, fig. 106 *prc*) held in their position relative to the heart by thin fibres. The generally accepted view is that the nephrocytes are excretory in function.

Central nervous system

The two cephalic centres of the nervous system, the brain and the suboesophageal ganglia, form one mass in this insect. In most adult Hymenoptera, the para-oesophageal connectives are described as short and robust; in this insect, all external identity of these connectives is lost; internally their traces can still be recognised in sections. Through the centre of this concentrated mass passes the alimentary canal.

Of the three primitive regions of the brain, the proto-cerebrum and

deuto-cerebrum are well marked. The treto-cerebrum is very difficult to make out and can only be marked by the origin of the two nerves going forward to the frontal ganglion of the visceral nervous system.

The proto-cerebrum, which forms most of the bulk of the brain, innervates the compound eyes and the ocelli. At its centre lies the central body (Plate III, fig. 19) with its superior and inferior capsules clearly marked (Plate III, fig. 19 *sus* and *ic*). The central body is flanked on each side by the prominent optic lobes which are clearly differentiated into the inner medullary mass (opticon) (Plate XIV, fig. 102 *opt*), the middle medullary mass (epiopticon) (Plate XIV, fig. 102 *epo*) and the outer medullary mass (perіopticon) (Plate XIV, fig. 102 *po*). Ventral to the inferior capsule of the central body originate the two peduncles of the corpora pedunculata or mushroom bodies (Plate III, fig. 19 *pdc*). Each peduncle curves outward and then splits into two branches forming one stalk. Each branch runs upwards close to the other, and, near the dorsal periphery of the proto-cerebral lobes, it carries a calyx (Plate III, fig. 19 *c*). The calyces are buried in the proto-cerebral lobes and do not show particular external dorsal bulging as they do in the case of bees, wasps and ants. Each calyx in *Microbracon hebetor* Say shows signs of splitting into two separate calyces, an upper and a lower one; thus in this respect they show a complexity which is worthy of consideration, since mushroom bodies are compared to the cerebrum of vertebrata and are regarded by many authors as the motor and psychic centres of the brain. This complexity is an index of the degree of reflex and psychic behaviour.

From the dorso-median region of the proto-cerebrum arise the three nerves innervating the ocelli, the median nerve is of double origin.

The simple and compound eyes are of the usual insect type which has been described by many authors and will not be further described here.

The deuto-cerebrum is composed of the two antennary or olfactory lobes and is situated antero-ventral to the proto-cerebrum. Each olfactory lobe consists of a central fibrous portion containing, peripherally, round bodies of more closely set fibres. These round bodies are sometimes referred to as glomeruli from their resemblance to the well-known structures in vertebrate olfactory lobes. The deeply-staining ganglionic cells forming the cortex of the olfactory lobes are larger than those forming the rest of the cortex of the brain. The deuto-cerebrum innervates the antennae.

Ventral nerve cord

The sub-oesophageal ganglion still shows its treble origin from the three primitive neuromeres (Plate XII, fig. 83). At its posterior end, it sends backwards, to the thorax and abdomen, the rest of the ventral nerve cord.

In leaving the head, the ventral nerve cord passes through the ventral partition of the occipital foramen. The connectives between the ganglia of the ventral nerve cord are double. In *Harmolita (Chalcidae)*, James (1926) describes these connectives as single, a state which he regards to be more advanced than the usual and more generalised double cord found in most insects.

In the thorax, the ventral nerve cord has two main centres. The anterior centre is the prothoracic ganglion which lies in front of and resting on the profurca. It innervates the prothoracic pair of legs. The second main thoracic centre of the nerve cord, lies in the region formed by the posterior part of the mesothorax and the anterior part of the metathorax. This ganglionic mass in unquestionably composed of the coalesced meso and metathoracic ganglia. The coalescence is not entire, and the identity of the meso and metathoracic ganglia can easily be observed. In a sagittal section, the posterior part of the metathoracic ganglion shows two faint constrictions, denoting that this ganglion is a compound one, composed of three ganglia. Thus the whole ganglionic mass is really composed of four ganglia, and belongs to the mesothoracic, metathoracic, first abdominal and second abdominal segments, because it innervates the meso and metathoracic wings and legs and their muscles, as well as the muscles of the first and second abdominal segments.

Just at the anterior end of the mesosternum, there is a comparatively small extra thoracic ganglia, which is apparently of a secondary development, and which sends small nerves to the median indirect wing muscles.

The number of nerve centres in the gaster of many Hymenoptera differs in different sexes (Imms, 1925, p. 537; James, 1926; Grandi, 1929). In *Doryctes (Braconidae)*, Seurat describes four centres in the male and three in female. In *Microbracon hebetor* Say the apparent number of nerve centres in the gaster of both male and female is four. But in longitudinal sections the last nerve centre of the male shows two constrictions, while that of the female shows only one (Plate XIV, fig. 101), a fact denoting that this centre is composed of one more ganglion in the male than it is in the female, and that there is really no great morphological difference between *Doryctes* and *Microbracon* in this respect.

The first abdominal ganglionic centre is situated just after the propodeum, the second is situated at the posterior end of the third segment, the third at the posterior end of fourth segment and the last occupies the fifth and sixth segments.

It is interesting to note that, it the female, the ventral nerve cord passes between the oviducts, beneath the alimentary canal, and that the last ganglionic mass is closely appressed to the dorsal region of the vagina, just above

the spermatheca; while in the male, the last ganglionic mass is situated dorsal to the anterior part of the combined mucous gland, and that the nerve cord does not pass between the two vasa deferentia.

Respiratory system

The respiratory system consists of the tracheal system and the spiracles. The tracheal system in this insect contains no air sacs. Seurat (1899) describes in details the tracheal system of *Doryctes gallicus* Reinh. (*Braconidae*) and compares it with that of *Microplitis seurati* Marshall (*Braconidae, Microgasteridae*). The tracheal system of *Microbracon hebetor* Say agrees with Seurat's description of that of *Doryctes*, for this reason, its description is not included in this paper, and only the spiracles are described, since Seurat did not describe the spiracles of any species studied by him.

The number of spiracles is ten pairs, three pairs are situated in the alitrunk and seven in the gaster. Morphologically, the two most anterior pairs of the alitrunk are the true thoracic, the third pair belongs to the abdomen and was shifted to the thorax with the first abdominal tergum forming the propodeum in this insect. This last pair resembles the abdominal spiracles in every detail and is essentially different from the true thoracic spiracle.

The first thoracic spiracle is situated in front of the anterior lower corner of the tegula, hidden under the lateral posterior corner of the pronotum, in a sort of membranous pocket. Externally it cannot be detected, and the best way of finding it, is carefully to dissect the pronotum and to examine it from the inside, the spiracles will be found near the edge (Plate VI, fig. 44 *sp*).

The second thoracic spiracle is situated between the meso and metapleura (Plate VI, fig. 40 *sp*), and owing to its minuteness it is usually difficult to find.

The remaining eight pairs of spiracles are all of the same structure and nearly the same size, and are situated segmentally at the lateral edge of the first morphological eight abdominal terga (Plate VI, fig. 40; Plate X, figs. 70 and 73; Plate XI, figs. 76 and 77).

Owing to the extreme minuteness of the two thoracic spiracles all attempts to work out their structure and mechanism with the available magnification were unsuccessful.

Each abdominal spiracle can be detected by its dark circular peritreme (Plate XIV, fig. 103 *per*). Externally the spiracle is exposed on the surface of the tergum and is not situated in a pocket or invagination; furthermore, it is not protected by hairs or spines (Plate XIV, fig. 103). The external spiracular opening is circular and has a diameter of 7-8 $\mu\mu$. It is situated in the centre of the circular peritreme. The chitinous covering from the

edges of the peritreme to the spiracular opening is thin and slightly coloured, a case which in many instances adds to the difficulty of finding the minute spiracular opening.

The spiracular opening leads to an outer chamber (Plate XIV, fig. 105). In many insects the inner surface of the walls of this chamber is covered by hairs or spines, in this insect, it is devoid of these structures, but is somewhat rough. At the bottom of this chamber there is a circular opening which leads to a shallow inner chamber (Plate XIV, fig. 105 *och*). This inner chamber corresponds to the *chambre de fermeture* of Janet (1902). The inner chamber immediately leads to two hollow chitinous structures (Plate XIV, fig. 104 *bo* and *lv*). One of these structures (Plate XIV, fig. 104 *bo*) is stationary and has its tip pointing towards the head; it gives attachment to the closing muscles, and in this connection it might correspond to the bow of some other insects. The other chitinous structure (Plate XIV, fig. 104 *lv*) is the lever, which is movable on its basis. Before the entrance to the lever there is a chitinous piece (Plate XIV, figs. 104 *cp* and 105 *cp*) which projects inwards, and at the entrance to the lever is the opening of the trachea.

When the closing muscles *om* (Plate XIV, fig. 104) contract *B* (Plate XIV, figs. 104 and 105), the lever is raised up and the opening of the trachea is brought against the chitinous piece (Plate XIV, figs. 105 *cp* and 105 *cp*) and is thus closed. When the opening muscles (Plate XIV, fig. 104 *opm*) pulls down the lever, the opening of the trachea is brought away from the chitinous piece and is thus put in communication with the inner and outer chambers (Plate XIV, figs. 104*A* and 105*A*).

The spiracle is richly supplied with nerves and trachea which ramify round the whole apparatus.

The best way of studying how the spiracle works, is to mount a living specimen in either glycerine or normal saline solution and to watch the last abdominal spiracle (this is chosen because the scleritisation is faint around it and one can see through better than in the case of other spiracles) under high magnification, with the help of a powerful « pointolite ».

Reproductive system

Male reproductive organs

Bordas (1894a) studied the male reproductive organs in representatives of several Hymenopterous families, but no Braconid example was included in his work. In *Microbracon hebetor* Say, the male reproductive organs consists of: (1) a pair of testes, (2) a pair of vasa deferentia which empty into (3) a combined pair of accessory or mucous glands leading to (4) a single short ejaculatory duct. There are no special vesiculae seminales.

The *testes* lie under the fifth and sixth abdominal terga, dorsal to, and resting on the alimentary canal (Plate XV, fig. 110). They are pear-shaped and have a strong yellow colour. In most individuals the two testes are medially connected together by a thin scrotum; in rare cases, some males have their testes separate.

Histologically, the wall of each testis is composed of an inner layer of degenerate epithelial cells which stain deeper (Heidenhain iron haematoxylon and Delafield's) than other layers. This layer of degenerate cells sits on a basement membrane outside which is a prominent coat of peritoneal connective tissue. Henschen (1928) showed that the rosette-shaped arrangement or cysts found during development in the testes and ovaries of the honey bee and other Hymenoptera are found in this insect only in the testes and not in the ovaries.

The *vasa deferentia* form a loop through which the alimentary canal passes (Plate XV, fig. 110). Histologically each vas deferens consists of an innermost layer of elongate glandular epithelial bordered by a basement membrane, to the outside of which are two layers of muscles, an inner circular, and an outer longitudinal. Covering the muscle layers is a well developed coat of peritoneal connective tissue.

Posteriorly, and just before entering the mucous-glands, the two vasa deferentia run close to one another and in this short region their peritoneal coverings become fused and form a common coat investing the two vasa. They then meet the mucous glands and the four canals become invested in a common coat of peritoneal connective tissue (Plate XV, fig. 108). Ultimately, eah vas deferens opens into the dorsal wall of the mucous canal of its side (Plate XV, fig. 109).

The *mucous* or *accessory glands* of this insect are not separate as they usually are in many other Hymenoptera (*Apis*, *Bombus*, *Vespa*, *Harmolita*, *Blastophaga* (last two are *Chalcididae*) and *Ophion* (*Ichneumonidae*). They are, in this insect, composed of two well developed tubular glands invested with a common coat of peritoneal connective tissue throughout their length, so that externally they appear single (Plate XV, fig. 110 and 112). They lie in the median ventral line of the abdominal cavity, and on the dorsal side of their anterior end lies the last abdominal ganglion. The two externally bound, but internally separate glands run backwards to open separately into the common ejaculatory duct, a short distance anterior to the exterior opening of the penis. It is interesting to note that in *Doryctes gallicus* Reinh. (*Braconidae*), Seurat (1899) does not describe any such glands; whether they are there and escaped his notice or whether they are really absent, the present investigator cannot exactly tell. If it were the second case and they are really absent, it is worth noticing that this morphological difference occurs in such closely related insects.

Where each vas deferens enters the gland of its side there is a lip or valve (Plate XV, fig. 109 *v*) which apparently closes the opening of the vas deferens when the secretion of the mucous gland travels backwards towards the ejaculatory duct.

Histologically the accessory glands are exactly similar to the vasa deferentia (Plate XV, fig. 107). The only structural difference between the vasa deferentia and the accessory glands is that the glandular epithelium of the accessory or mucous glands is composed of cells which are longer and more active in secretion than the corresponding cells of the vasa deferentia. According to Bishop (1920), in the honey bee there is a third innermost layer of longitudinal muscles extending from the base of each gland more than half way to its anterior end. This muscular layer is missing in the case of *Microbracon hebetor* Say and only two layers are found, an inner circular and an outer longitudinal which are a continuation of the two layers of the vasa deferentia.

The glandular epithelium of the vasa deferentia and of the mucous glands, early in the life of the male, undergoes an erosive process after which only the basal remnants of these cells are left (Plate XV, fig. 109).

The *ejaculatory duct* is a single very short canal. Its wall is composed of a layer of small cubic epithelial cells internally lined with chitinous intima. There are two layers of muscles, an inner circular, and an outer longitudinal which are a continuation of the muscle layers of the mucous glands. The coat of the peritoneal connective tissue covering the testes, the vasa deferentia, and the accessory glands, does not extend over the ejaculatory duct.

Male genitalia

At present there is no agreement on the terminology used for the male genitalia of Hymenoptera. Zander (1900) and Boulangé (1924) tabulate the greatly involved synonymy of these parts. In this paper, however, Zander's nomenclature is adopted.

The genitalia of *Microbracon hebetor* Say are situated between the morphological ninth and tenth sterna, and consist of the following parts:

(1) A basal ring-like piece (Plate XV, fig. 111 *bp*) which has a large triangular ventral surface, and a narrow dorsal one. The dorsal surface is feebly scleritised and is attached to the membrane between the ninth and tenth sterna. The ventral surface is thickly scleritised at its anterior part, but its posterior part is membranous, presumably to give the rest of the genitalia free movement.

(2) Articulated to the basal piece, and embracing the other parts of the genitalia, are the two external valves (Plate XV, figs. 111 *exv*, 112 *exv* and 113 *exv*) or claspers, one on each side of the median line. Distally, each

external valve bears a group of long tactile sensory hairs. On their outer side the external valves are scleritised, but on their inner side they are membranous (Plate XV, fig. 113). Ventrally the two external valves do not meet medially (Plate XV, fig. 111), but dorsally they meet above the penis for a short distance (Plate XV, fig. 112).

(3) Articulated to the ventral base of each of the external valves, and in many cases attached to it by a narrow neck, is the internal valve (Plate XV, figs. 110 *inv*, 111 *inv*, 112 *inv* and 113 *inv*), which is concave and scleritised on its ventral side (Plate XV, fig. 113). On its distal end each internal valve, or volcella of some authors, bears a versatile process (Plate XV, figs. 110 *invp*, 111 *invp* and 112 *invp*). This process bears numerous sensillae (Plate XV, fig. 111 *sn*), and moves very actively when the male is about to copulate.

(4) The penis is relatively large and is situated medially dorsal to the inner valves (Plate XV, figs. 111 *p*, 112 *p* and 113 *p*). Ventrally the penis has an elongated keel (Plate XV, figs. 111 *pk* and 113 *pk*). On each side of the keel, the ventral wall of the penis has a longitudinal well scleritised ridge (Plate XV, figs. 111 *sz* and 113 *sz*) which gives attachment to the longitudinal muscles of the organ. Zander (1900) says that these two ridges indicate the double origin of the penis. The genital opening is situated at the tip of the penis, somewhat to the ventral side (Plate XV, fig. 110 *po*). Ventrally, and at its posterior end, the penis bears numerous sensillae, shown as dark spots in Plate XV, figure 111.

Running in the basal cavity of the genitalia are two strong chitinous struts (Plate XV, fig. 111 *chs*) which give attachment to the well developed longitudinal muscles of the internal and external valves. The anterior ends of these struts are free in the basal cavity of the genitalia; their posterior ends are not so strong, and are embedded at the bases of the processes of the inner valves.

What is here termed the penis correspond to a part of the true aedeagus of other insects formed of the penis and parameres. The internal valves are the parameres. The external valves are the coxites of the ninth segment. With regard to the basal piece, Singh Pruthi (1924) writes « No account of the development of this region is available, but from the position of the cardo (basal piece), between the ninth sternum and its coxites, it appears that Zander was correct in considering this piece to be a part of the ninth ternum ». It appears that Singh Pruthi overlooked Zander's account of the development of this piece in *Vespa germanica* L.. Zander (1900) showed that the basal piece (cardo) develops as a single pad from the ventral and lateral base of the rudimentary genital buds. This will eliminate the idea that the basal piece is a part of ninth sternum; it is categorically a part of the genitalia, and its homology is, at present, not clear.

Female reproductive organs

The female reproductive organs lie entirely in the abdomen. They consist of a pair of ovaries situated one to the left, the other to the right of the alimentary canal. Each ovary consists of two ovarioles (Plate XVI, fig. 114) which, at their posterior end, empty into a very short oviduct (Plate XVI, fig. 114 *ovd*). The two oviducts run obliquely and ventrally to unite in the median line forming the common oviduct followed by the vagina (Plate XVI, fig. 114 *va*), which runs medially, ventral to the alimentary canal, and then opens between the eighth and ninth sterna. The spermatheca is situated in the dorsal anterior region of the vagina (Plate XVI, fig. 114 *spm*). In *Dorycles*, Seurat (1899) describes a colletrial gland, which is spherical in form and acinous in structure, and which opens medially behind the spermatheca. In *Microbracon hebetor* Say, the present investigator did not find any colletrial glands.

The *ovarioles* present remarkable variation in size according to season and nutrition. In winter, and when the insect does not feed on nitrogenous food, the ovarioles are very short, barely half a millimetre in length, and contain no eggs or oocytes. When the warm weather sets in, and the insect feeds on its usual nitrogenous diet, the ovarioles are greatly enlarged. The average length of each ovariole is then 5 mms. As the abdomen is only 1.8 mm. in length, the ovarioles are consequently folded on themselves (Plate XVI. fig. 114) and nearly fill the whole abdominal cavity squeezing the other organs. They are then full of oocytes and eggs.

At its posterior end, each ovariole is distended to form a calyx or reservoir (Plate XVI, fig. 114 *cx*), in which the mature eggs are stored until they are laid. In most insects the calyces are formed in the oviducts and not in the ovarioles. *Chalcididae* agree with *Braconidae* in having the calyces in the ovarioles and both differ from *Ichneumonidae* in which the calyces are formed in the oviducts.

The ovarian wall is very thin, less than 2 μμ, and is composed of small epithelial cells, to the outside of which is a layer of tunica propria. According to Henschen (1928) these epithelial cells are more developed in the pupa than they are in the adult.

Four regions can be distinguished in each ovariole:

(1) An apical region containing a syncytium of elongated nuclei. This region is of a very narrow calibre.

(2) A region which contains small cells of similar size and cytology. This is the end chamber or *germarium*. Regions (1) and (2) occupy a short terminal part (Plate XVI, fig. 114 *tf*).

(3) A region where nutritive cells alternate with the developing ova. This region is the *vitellarium* and is the longest of all regions (Plate XVI,

fig. 114 *vt*). Since there are nutritive cells in the ovariole it is thus of the type known as *meroistic;* and since the nutritive cells alternate with the oocytes in the vitellarium (Plate XVI, fig. 115), the ovarioles are of the type recognized as polytrophic which is common in Hymenoptera.

(4) A region marked by the presence of mature or almost mature ova, and by the absence of nutritive cells and follicular epithelium.

There is no ovarian ligament in this insect. Each two ovarioles of one side are terminally connected together by a short thin yellow tissue which is easily torn off in the dissection. The ovarioles thus end freely in the body cavity. In *Chalcididae* (Baird, 1921, and James, 1926), the ovarioles generally adhere to one another longitudinally, but can easily be separated In *Microbracon hebetor* Say and other *Braconidea* they are longitudinally free

Each *oviduct* is a distendable short tube constituted of a thin internal epithelial layer with a basement membrane and an outer coat of circular muscles. The two oviducts unite to form a common oviduct which is very short and lies at the anterior of the vagina.

The *vagina* is a short comparatively wide tube. It is internally lined with a thin cuticular layer and has an external coat of circular muscles. At its anterior dorsal region is situated the opening of the spermathecal or seminal duct. It gives attachment to numerous muscles which originate on the eighth sternum and pleura; these muscles presumably help in oviposition.

The *spermatheca* is small and absolutely spherical. According to Seurat (1899) it is cylindrical in *Doryctes gallicus* Reinh.. In *Microbracon hebetor* Say it has a well scleritized and relatively thick chitinous intima, which is strongly testaceous in colour. The diameter of the spermathecal lumen is 25 μμ and the thickness of the wall is 6 μμ. Outside the chitinous intima, there is one layer of prominent epithelial cells bordered by a basement membrane, outside which is a coat of muscles. There are two spermathecal glands which are short and tubular, and which open by a short common duct into the anterior dorsal region of the spermatheca. The spermatheca, in its turn, opens into the vagina by a short seminal duct.

Female genitalia

The female genitalia are modified to serve both for oviposition and for piercing. They lie in the eighth and ninth abdominal sterna, which are invaginated to form the genital chamber. But the posterior part of the genitalia always projects beyond the abdomen (Plate X, fig. 70). The female genitalia consist of the following parts.

(1) The quadrate or outer plates (Plate XI, fig. 76 *qp*) which are, in fact, lateral prolongation of the ninth tergum (Plate XI, figs. 76 and 77). In some Hymenoptera, the dorsal part of the ninth tergum is either missing or mem-

branous. This fact led Berlese (1909) to regard the quadrate plates as parts of the eighth sternum since, in repose, they lie ventrally and are overlapped by the eighth tergum. However, evidence from developmental history and comparative anatomy leaves no doubt now that the quadrate plates are parts of the ninth abdominal tergum.

Running along the length of each quadrate plate are two scleritised ribs, a faint middle one (Plate XI, fig. 78 *qr*) and a comparatively strong lateral one (Plate XVI, fig. 118 *qrs*). The lateral rib gives attachment to muscles from the inner plate (Plate XVI, fig. 118 *op*).

The quadrate plate articulates to a triangular or fulcral plate (Plate XI, figs. 76 *tp* and 78 *tp*; Plate XVI, fig. 118) and overlaps the oblong or inner plate (Plate XVI, fig. 118 *op*).

(2) The triangular or fulcral plate (Plate XI, fig. 76 *tp*) articulates by one of its three corners to the quadrate plate as was already mentioned, by the second corner it articulates with the inner plate, and by the third corner it articulates with the diverging arm of the stylet (Plate XVI, fig. 118). Moreover it is attached by muscles to all these parts and thus plays an important role in the movements of the apparatus. Morphologically it is a part of the eighth sternum as was shown by Zander (1899) in the honey-bee.

(3) The inner or oblong plates (Plate XI, fig. 76 *op*) are situated to the inside of the quadrate plates. At its basis each oblong plate enlarges into a lamina which articulates with the diverging arm of the stylet sheath (Plate XVI, fig. 118). In the inner side of the oblong plate there is a short, heavily scleritised rib (Plate XI, fig. 78 *or*; Plate XVI, fig. 118 *or*), and on its outer edge is another longer and stronger rib, which has its origin at the articulation with the fulcral plate (Plate XI, fig. 78 *n*; Plate XVI, fig. 118 *ors*). Both ribs give attachment to muscles. At its articulation with the fulcral plate, the inner plate is curved inwards and carries numerous sensillae (Plate XI, fig. 78 *sn*; Plate XVI, fig. 118 *sn*).

Posteriorly the oblong or inner plate is elongated into a palp-like process (Plate XI, figs. 76 *gd* and 78 *gd*), which is clothed on its outer side with long sensory hairs, its inner side is devoid of these hairs (Plate XI, fig. 80). The anterior part of the palp-like process is thrown into numerous folds to allow bending; the the posterior part is enlarged into a club-shaped end, and is devoid of folds (Plate XI, fig. 80). The inner side of the process has a longitudinal groove which runs along its entire length; when this groove is applied to the groove of the other palp-like process a tube is formed. In this tube the interlocked stylets and stylet sheath are lodged when the genitalia is not in action. The groove becomes finer at the posterior tip of each palp-like process (Plate XI, fig. 80); it is with these tips that the stylet and stylet sheath are guided by the palp-like processes in piercing the victim, and the

fineness of the grooves at this part ensures accurate holding. Each palp-like process is innervated by a nerve (Plate X, fig. 82 *nv*) and supplied by a trachea (Plate XI, fig. 82 *tr*).

In *Blastothrix* (*Chalcidae*), Imms (1918) found a joint between the inner plate and the palp-like process; there is no corresponding joint in *Microbracon hebetor* Say. Seurat (1899) is not clear on this point in *Doryctes*.

Morphologically the oblong or inner plate is a part of the ninth sternum, and the palp-like process is a development of the ninth sternum.

(4) The stylet sheath is a long median piece apparently formed of two longitudinal pieces united along the middle line (Plate XI, fig. 82 *sh*). Along its ventral side the stylet sheath has two guide rails which neatly fit into corresponding stylet grooves. At its basis the stylet sheath enlarges to form a bulb (Plate XI, fig. 78 *shb*) which receives the secretions of the acid and alkaline glands. On its latero-ventral surface the bulb of the sheath has several sensillae (Plate XI, fig. 78 *sn*).

The bulb is formed by the bulging out of the dorsal and lateral walls of the sheath. The middle wall (Plate XI, fig. 82 *d*) disappears and one large cavity is formed (Plate XVI, fig. 119). On the disappearance of the middle wall (Plate XI, fig. 82 *d*) the ventral wall of the bulb becomes membranous at its middle line.

Towards the anterior of the bulb each side of the ventral wall branches into two. One outer branch which carries the guide rail, and an inner branch (Plate XVI, figs. 119 *dl* and 119 *dr*). Ultimately the outer branch diverges dorso-laterally with the stylet of its side and articulates with the lamina of the inner plate as was already mentioned. The inner branch (Plate XVI, fig. 119 *dl* or 119 *dr*) extends anteriorly in the ventral wall of the bulb until it ends.

The latero-dorsal walls of the sheath bulb are strengthened with two strongly scleritised ridges (Plate XVI, fig. 117 *sz* and 119 *sz*). The dorsal wall is relatively thin.

Anteriorly the bulb is drawn into a narrow blind end which is thickly scleritised (Plate XVI, fig. 117), and which gives attachments to muscles from the outer ribs of the oblong plates.

The posterior tip of the sheath has a dorsal keel (Plate XI, fig. 79). It bears no barbs or serrations, a fact which suggests that the sheath does not take part in forming the wound.

Morphologically the stylet sheath is a development of the anterior gonapophysis of the ninth sternum.

(5) The stylets (Plate XI, fig. 82 *st*) are separate throughout their entire length. In cross-section they are subtriangular and hollow (Plate XI,

fig. 82). They are of the same length as the stylet sheath and as the inner plate (Plate XI, fig. 78 *op*) together with its process (Plate XI, fig. 78 *gd*). Anteriorly each stylet diverges dorso-lateral from the median line and articulates with the fulcral plate of its side. At its posterior tip each stylet has five barbs on its lateral outer side (Plate XI, fig. 81 *b*) by which the wound is formed in the victim.

In *Doryctes*, Seurat (1899) writes that near the anterior region of the stylet sheath, each stylet bifurcates; one of the branches run forwards to articulate with the eighth sternum. There is no corresponding branch in the stylet of *Microbracon hebetor* Say; furthermore in the hymenopterous ovipositors described by Imms (1916 and 1918), James (1926) and Grandi (1929), and in the sting of the honey-bee the stylet is an unbranched process.

Morphologically the stylet is a development of the gonapophysis of the eighth sternum.

Thus the female genitalia of *Microbracon hebetor* Say are fundamentally composed, as in other insects, of three pairs of gonapophyses, and of the quadrate plate which is part of the ninth tergum, the fulcral plate which is part of eight sternum, and the oblong plate which is part of ninth sternum.

The glands of the sting

The glands of the sting consist of two systems: a simple alkaline gland, and a complex system of acid glands. The present investigator was unable to find the third or accessory poison glands described by Bordas (1897) in *Ichneumonidae*. The so-called « lubricating glands » described by Snodgrass (1925) in *Apis mellifica* L. are missing in this insect.

Alkaline gland

The alkaline gland is situated between the plates of the sting. It is an elongated transparent tube; and its external surface is somewhat folded and extremely fragile. Its posterior end is dilated (Plate XVII, fig. 121); and as the gland runs forward, it gets narrower, until it opens directly with a short neck 8-10 $\mu\mu$ in diameter into the anterior part of the stylet sheath bulb.

The wall of the alkaline gland is devoid of muscles, and consists of one layer of glandular epithelium bordered by a basement membrane to the outside, and internally lined by a chitinous intima. The epithelial cells are big very distinct and polyhedral (Plate XVII, fig. 122). Their nuclei are round, and extremely poor in chromatin.

Acid glands

The acid glands form a well developed and unique apparatus, which is situated to the right of the median line of the abdomen, dorsal to the posterior end of the ovarioles of its side and consists of the following parts:

(1) A well developed oval reservoir devoid of any glandular elements (Plate XVII, fig. 120 *r*).

(2) A group of eight elongated turgid tubes, neatly arranged round the reservoir and held together in their position by a rich ramification of trachea (Plate XVII, fig. 121). These tubes are glandular, and open separately in a circle, at the posterior end of the reservoir, in a special vestibule (Plate XVII, fig. 125 *v*).

(3) A common glandular duct (Plate XVII, fig. 121 *cgd*), the lumen of which is only 4-5 μμ in diameter. This duct is comparatively long and enters the bulb of the stylet sheath on its left side (Plate XVI, fig. 116 *cgd*) and runs posteriorly for a short distance before it ends.

The reservoir is internally lined by a strong chitinous layer which, at regular intervals, is thickened into folds forming a well developed spiral (Plate XVII, fig. 125 *s*). This internal chitinous structure has a strong testaceous colour which, in dissecting, helps in finding the whole apparatus, otherwise difficult to find on account of its transparency and minuteness. Outside the chitinous layer of the reservoir, there is a zone of strong longitudinal muscles, which are inserted in bundles on the ridges of the spiral (Plate XVII, fig. 126). In *Doryctes*, Seurat (1899) describes a layer of inner circular muscles and an outer layer of longitudinal muscles on the reservoir. In *Microbracon hebetor* Say, there are no circular muscles (Plate XVII, fig. 127). The narrow posterior end of the reservoir is somewhat dilated into a vestibule into which the glandular tubes open by eight separate orifices. At its posterior end this vestibule leads to the common glandular duct.

The glandular tubes are not always of the same length or diameter but differ in different individuals and also in the same individual (Plate XVII, fig. 120). In many cases two or three of these tubes are of a size double that of the rest. Not infrequently, one or two tubes are bifid at their free end (Plate XVII, fig. 120). Each tube opens by a short narrow duct into the vestibule of the reservoir.

Histologically, the wall of each tube is composed of one layer of glandular epithelium lined with a thin chitinous intima and bordered by a basement membrane (Plate XVII, fig. 123). The epithelial cells are distinct, polyhedral and with big round nuclei which are very poor in chromatin. These cells are more active in their secretion than the glandular cells of the alkaline gland. The walls of the glandular tubes are devoid of muscles.

The common glandular duct is lined internally by a comparatively thick chitinous layer, outside which is a layer of columnar distinct cells covered with a thin membrane easily torn off (Plate XVII, fig. 124). Between the necks of the columnar cells are found numerous unicellular glands 2-3 μμ in diameter (Plate XVII, fig. 124 *ung*). Each gland opens separately into the lumen with a very short and narrow duct. Bordas (1897 and 1908), Janet (1898), Seurat (1899) and Pavlovski (1914) do not describe these minute unicellular glands; in the figure given by Genieys (1925) for *Microbracon brevicornis* Say poison apparatus, these glands are not shown, however, no description of the apparatus is given in his paper. Until the reaction of their separate secretion is known, one cannot speculate on the function of these unicellular glands. A short distance before entering the sheath bulb, the common glandular duct becomes devoid of its cells, and only a canal formed of the remaining inner thick chitinous lining enters the sheath bulb.

There is a great deal of variation in the form and structure of the acid glands and their reservoir among *Braconidae*. Seurat (1899) describes five different types, all of which differ from that of *Microbracon hebetor* Say just described. According to him, the form and structure of the glands and their reservoir remain constant in the one tribe, so that they can be used as diagnostic characters to that tribe. But, in the opinion of the present investigator, the work done in that field is not sufficient to warrant such a statement.

There is no doubt, that the reservoir in this insect acts also as a pumping apparatus, for driving out the secretion of the glandular tubes into the common glandular duct, and for pumping the secretion from the lumen of the tubes into its own lumen. When the powerful longitudinal muscles of the reservoir contract, the volume of the reservoir is decreased, and some of its fluid contents is driven backwards to the opening of the common glandular duct, which, at the same time, is drawn forwards into the vestibule by the muscle contraction. When the opening of the common glandular duct is drawn into the vestibule, the slanting openings of the glandular tubes are closed and thus the influx of the outgoing fluid into these tubes is prevented. On the relaxation of its longitudinal muscles, the reservoir resumes its former volume by the elasticity of the chitinous spiral, and in so doing, it draws some of the secretion of the eight glandular tubes into its cavity.

The alkaline gland is situated between the quadrate and oblong plates of the « sting », and it is very probable that, in stinging, the gland is squeezed between these plates and thus its secretion comes out.

IX. SUMMARY

(1) *Microbracon hebetor* Say has four larval instars. The alimentary canal and respiratory system of the last instar are described.

(2) In the adult insect the head and its appendages are described. Only labro-clypeus, clypeo-frontal and gular sutures are found.

Tentorium has its anterior arms forming main part, dorsal arms are attached to ocular sclerite, posterior arms are very short and have no pits, body of tentorium forms a bridge across occipital foramen.

Antennae are described in some detail. The male flagellum is longer than that of the female. Deformation is frequent in flagellum. Through each antenna run a double nerve, a trachea and a blood vessel. Antennal muscles do not extend distally more than the basis of the pedicel. Rhinaria are sunk canaliculus of the antennal wall covered with membrane, and in the middle of each is situated an elliptical placoid sensilla. The rhinaria are found only on the flagellum and give it a ribbed appearance. Number of rhinaria is not the same on both antennae of each individual and is different in both sexes. Results of actual counts from cross-sections are given in Table II; in a male, left antenna has 292 rhinaria, right antenna 279; in a female, left antenna has 171 and right has 166. The nerve branch from each placoid sensilla joins the antennal double nerve in the segment proximal to that in which the sensilla is situated. That the rhinaria contain fluid suggests that the placoid sensillae are probably olfactory. Johnston's organ is found and described. Bischoff (1927) states that placoid sensillae are the only type found in *Braconidae*. Trichoid as well as coeloconic sensillae are found on the flagellum of this insect and are described.

The mouth parts are adapted for biting and lapping and consist of: epipharynx, hypopharynx, labrum, labium, maxillae and mandibles all of which are described.

(3) The exo- and endoskeleton of the thorax are described and figured in details and represent a specialised Hymenopterous thorax. The first abdominal tergum is solidly attached to the thorax.

The wings have three axillary sclerites at the base of each. Sensillae are found at bases of all wings, and at the parastigma of the mesothoracic pair. Venation of both wings is described on both Comstock-Needham system and Marshall's system of *Braconidae*. Wing coupling apparatus consists of a thickened rib in the mesothoracic and three hamuli in the metathoracic wings. Direct and indirect wing muscles are described.

In the legs the three coxae are different in size and shape. The so called second trochanter segment is shown to be a proximal part of the femur. Praetarsus is described in some detail and consists of two claws, and a median adhesive organ strengthened dorsally by the orbicula, and ventrally by the

calcanea to which the tarsal tendon is attached. The distal part of the median adhesive organ is the arolium which has at its ventral side a chitinous bow. A table of nomenclature used by different authors for the different parts of the pretarsus is given. The way by which the insect ascends and descends smooth perpendicular glass and walks on the underside of horizontal smooth surfaces is not clear.

(4) The abdomen is composed of ten segments. The sterna are mostly membranous. The first abdominal sternum still lies in the abdomen and has not been shifted to the thorax as the first abdominal tergum. The male genital opening is between the ninth and tenth sterna, the female genital pore lies between the eighth and ninth sterna. The cerci are one-segmented and are situated in the membranous part posterior to the ninth sternum.

A gland on the eigth abdominal tergum of the male is newly described.

(5) All parts of the alimentary canal are described in some detail. Pharynx has a pharyngeal plate in its ventral wall; on this plate there are two groups of gustatory sensillae. Three longitudinal folds are described in the proventriculus. The cardiac invagination « valve » does not extend very far in mid-gut. Striated hem of mid-gut forms peristrophic membrane. Malpighian tubes are 12-14, and open between and hind gut. The rectal pads « glands » are four in number and are described in some detail. Thoraci-glands open by a common duct on dorsal side of labium.

(6) Blood has a faint yellowish tinge and contains few granular leucocytes. There is a dorsal diaphragm situated in the gaster, but no ventral diaphragm. Heart extends from seventh to second abdominal segments. Aorta bifurcates in head giving a branch to each antenna. Heart has five chambers and five pairs of ostia.

(7) The central nervous system is described. Mushroom bodies are well developed. In thorax main nerve centres are two and there is a small sécondary centre between them. In the gaster the apparent number of ganglionic centres is four in both sexes, but sections reveal that the last ganglionic centre is composed of one ganglion more than that of the female.

(8) The tracheal system of *Microbracon hebetor* Say agrees with that of *Doryctes gallicus* Reinh. which is described in detail by Seurat (1899); therefore its description is not included in this paper. The spiracles of *Microbracon hebetor* Say are described and the structure and mechanism of an abdominal spiracle is described in detail.

(9) Male reproductive organs are described in detail. There are no special vesiculae seminalis. The accessory glands, unlike the case in many other Hymenoptera, are externally bound together but internally they are separate; ejaculatory duct is very short. Histology of the organs is described.

Male genitalia consist if a basal piece whose homology is not clear, two

external valves which are the coxites of the ninth sternum, two internal valves with their processes which are the parameres, and the penis which is formed by the fusion of the two penis lobes and is thus homologous with the aedeagus in other orders.

The reproductive system of female is described. Each ovary has two polytrophic ovarioles. There is no ovarian ligament. The two oviducts are short, vagina short and wide. Spermatheca spherical with two tubular spermathecal glands. There are no collateral glands; the structure of the system is described.

The female genitalia are fundamentally composed as in other insects of three pairs of gonapophyses, and of the quadrate plate, which is part of the ninth tergum, the fulcral or triangular plate which is part of the eighth sternum, and the inner or oblong plate which is part of the ninth sternum. The stylet sheath has no barbs, the stylet has five barbs on its lateral outer side. All parts are described in detail.

(10) The glands of the sting and their histology are described in detail. The alkaline gland is single gland which open directly at the anterior end of the bulb of the stylet sheath. The acid glands are formed by a complex apparatus consisting of eight tubular glands surrounding a non glandular reservoir and having in common with it a duct which is also glandular. This duct enters the bulb of the stylet sheath on the left side and opens in it. The walls of the duct have two kinds of cells, columnar cells which are easily separated from one another, and, at their necks, small spherical cells which open with short ducts in the lumen of the common duct; these small spherical unicellular glands were not described by Bordas (1897 and 1908), Janet (1898), Seurat (1899) and Pavlovski (1914), and thus are new finding.

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PLATES I-XVII

Explanation of Plate I

Fig. 1. — The mating position. — × 12.

Fig. 2. — The egg. — × 28.

Fig. 3. — First larval stage (dorsal view). — × 60.

Fig. 4. — Last larval stage (side view). — × 20.5.

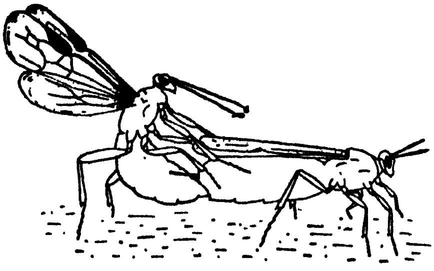
Fig. 5. — Prepupa (ventral view) : The black substance at the posterior end of the cocoon is the faeces. — × 24.

Fig. 6. — Female pupa (ventral view). — × 24.

Fig. 7. — Female adult (dorsal view). — × 20.

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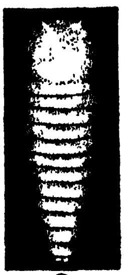
Plate I



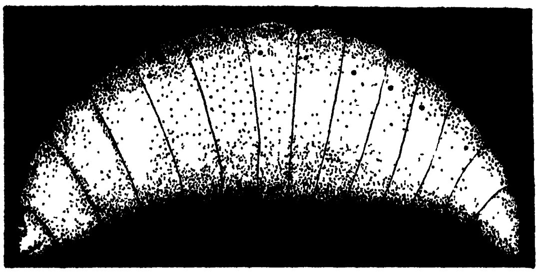
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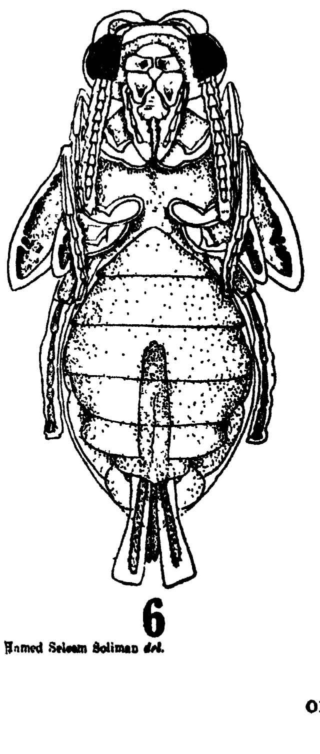
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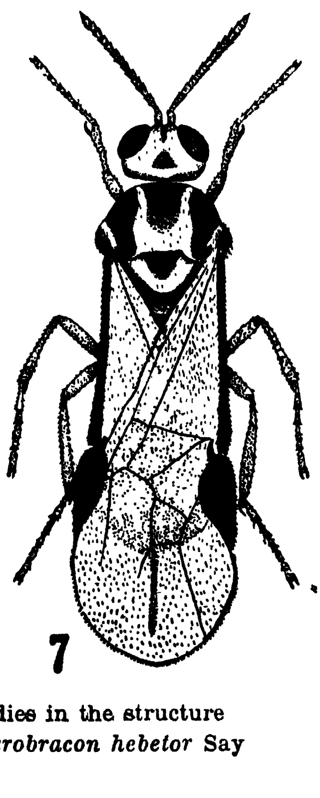
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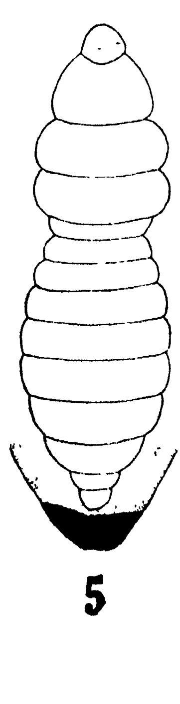
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Explanation of Plate II

Fig. 8. — Tracheal system of the last larval instar (side view), and an enlarged spiracular branch with spiracle at the end. — × 34.5.

Fig. 9. — Tracheal system of last larval instar (ventral view). — × 20.

Fig. 10. — Head, pro- and mesothorax of last larval instar (ventral view) : The mouth parts are clearly shown. Labium in the middle with two labial palps to the posterior and the opening of the salivary gland to the anterior. On both sides are the maxillae with thin palps which is seen in the middle. The mandibles and labrum can also be seen. — Enlarged.

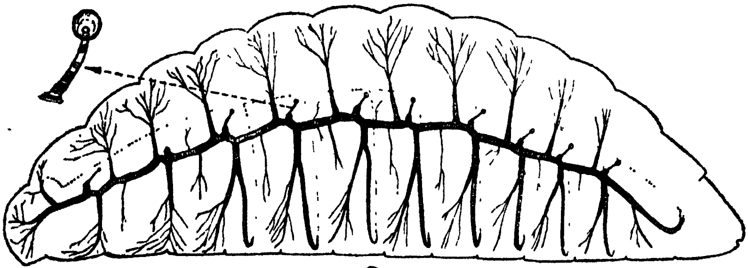
Fig. 11. — Schematic diagram showing alimentary canal and salivary glands: *a*, anus ; *m*, mouth ; *mg*, mid-gut ; *mt*, malpighian tubules ; *osg*, opening of salivary glands ; *sg*, salivary glands. — × 19.

Fig. 12. — Median longitudinal section in the posterior end of the larva : *a*, anus ; *hg*, hind-gut ; *mg*, mid-gut ; *mgw*, mid-gut wall ; *mt*, malpighian tubules ; *pm*, periotrophic membrane ; *sg*, salivary glands. — × 100.

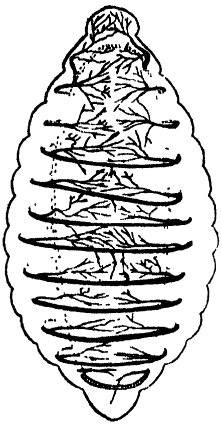
Fig. 13. — Median longitudinal section in the anterior end of the larva ; *m*, mouth ; *mg*, mid-gut ; *ph*, pharynx ; *pm*, periotrophic membrane ; *sg*, salivary gland ; *sub.œs.g*, sub œsophageal ganglion. — × 100.

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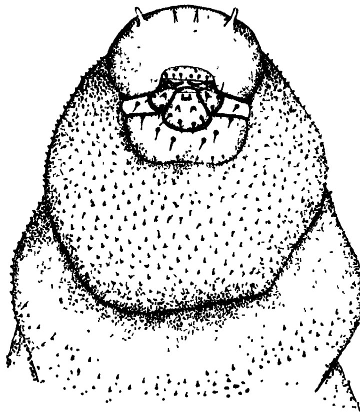
Plate II



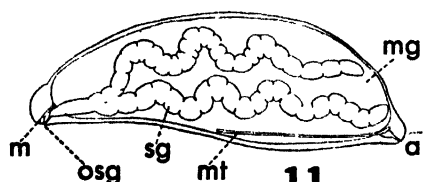
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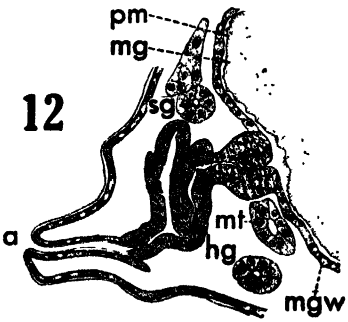
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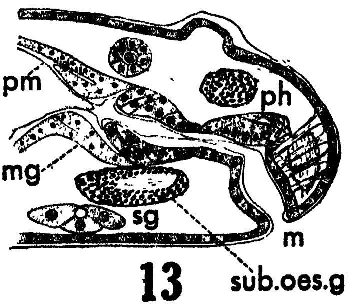
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Explanation of Plate III

Fig. 14. — Anterior aspect of head : *cly*, clypeus ; *lbr*, labrum ; *md*, mandible : *mxp*, maxillary palp ; *oc*, ocellus ; *tnp*, tentorial pit. — × 80.

Fig. 15. — Posterior aspect of head : *cd*, cardo ; *lbm*, labium ; *md*, mandible ; *mxp*, maxillary palp ; *oc*, ocellus ; *st*, stipes ; *tnb*, tentorial body seen through the occipital foramen. — × 80.

Fig. 16. — Cross-section in antenna passing through the telescoped distal end of the pedicel into the proximal end of the first segment of flagellum : *bv*, blood vessel ; *fl1*, first segment of flagellum ; *jp*, pit of Johnston's organ ; *nv*, nerve ; *pd*, pedicel ; *tr*, trachea. — × 80.

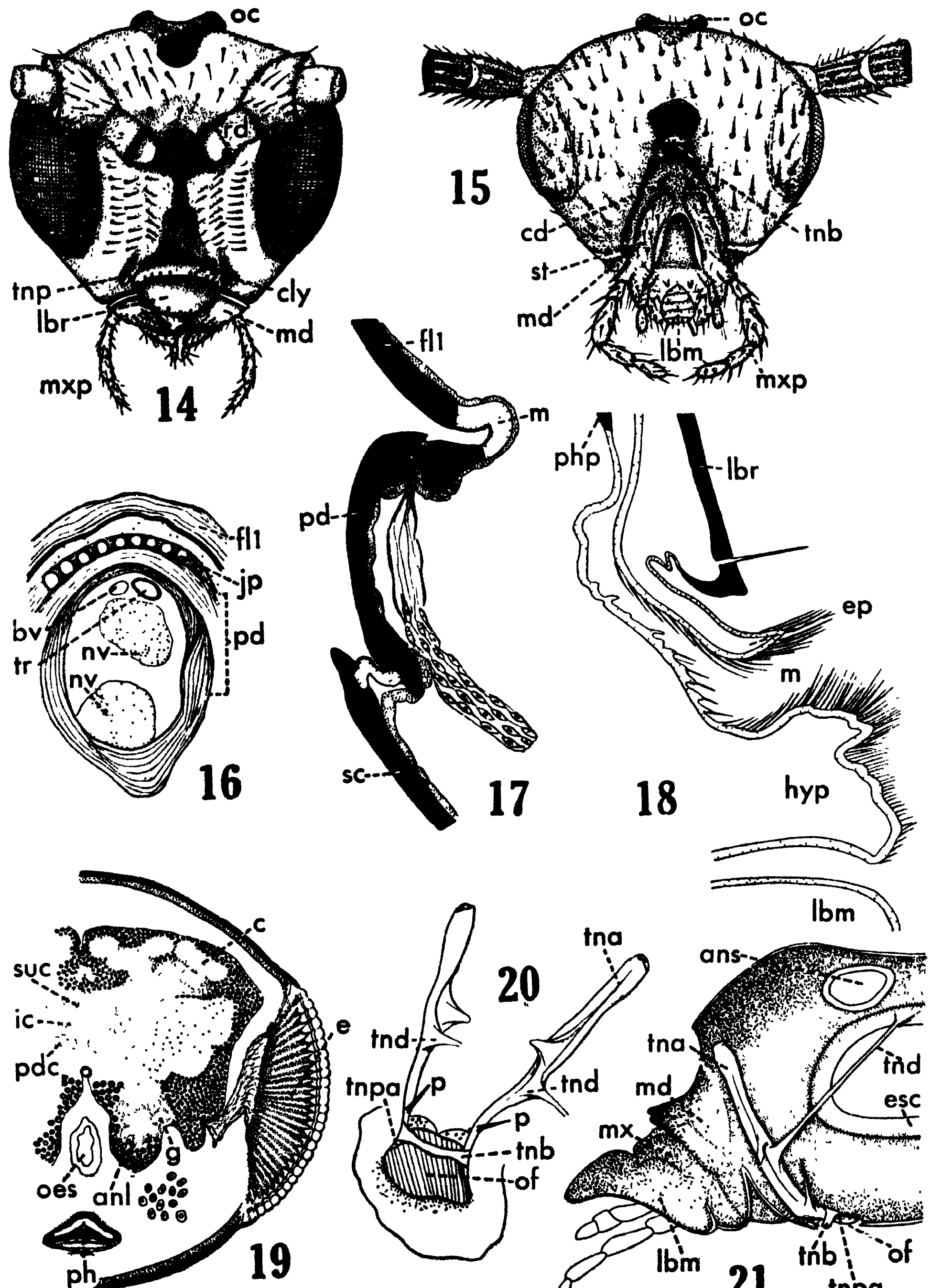
Fig. 17. — Longitudinal section passing through left wall of proximal end of antenna and through one of the pits of Johnston's organ : *fl1*, first segment of flagellum ; *m*, articulatory membrane ; *pd*, pedicel ; *sc*, scape. — × 736.

Fig. 18. — Median longitudinal section through mouth : *ep*, epipharynx ; *hyp*, hypopharynx ; *lbm*, labium ; *lbr*, labrum ; *m*, mouth ; *php*, pharyngeal plate (distal tip). — × 640.

Fig. 19. — Frontal section in left side of head : *anl*, antennal lobe of brain : *c*, calyx of mushroom body ; *e*, compound eye ; *g*, glumeruli ; *ic*, inferior capsule of the central body of protocerebrum ; *oes*, oesophagus ; *ph*, pharynx ; *pdc*, peduncle of mushroom bodies ; *suc*, superior capsule of the central body of cerebrum (the root of median ocellar nerve can be seen dorsal to *suc*, and it is clear that it is of double origin). — × 140.

Fig. 20. — Tentorium dissected out with a piece of the occiput (posterior aspect) : *of*, occipital foramen ; *p*, chitinous process ; *tna*, anterior arms ; *tnb*, tentorial body ; *tnd*, dorsal arms (cut near their origin from the anterior arms ; *tnpa*, tentorial posteriol arms. — × 96.

Fig. 21. — Right side of head capsule seen from inside : *ans*, antennal socket ; *esc*, eye sclerite ; *lbm*, labium ; *md*, mandible ; *mx*, maxilla ; *of*, occipital foramen ; *tna*, tentorial anterior arm ; *tnb*, tentorial bridge or body, cut ; *tnd*, tentorial dorsal arm ; *tnpa*, tentorial posterior arm. — × 84.



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Explanation of Plate IV

Fig. 22. — Labrum and epipharynx dissected out with some muscles (posterior aspect) : *cp*, epipharynx ; *lbr*, labrum ; *sn*, sensillae in dorsal wall of pharynx. — × 188.

Fig. 23. — Left mandible (dorsal view) : *abdm*, abductor muscles ; *adm*, adductor muscles. — × 188.

Fig. 24. — Right maxilla (outside aspect) : *cd*, cardo ; *g*, galea ; *l*, lacinia ; *st*, stipes. — × 188.

Fig. 25. — Cardines (dorsal aspect) : *cd*, cardo ; *st*, stipes. — × 188.

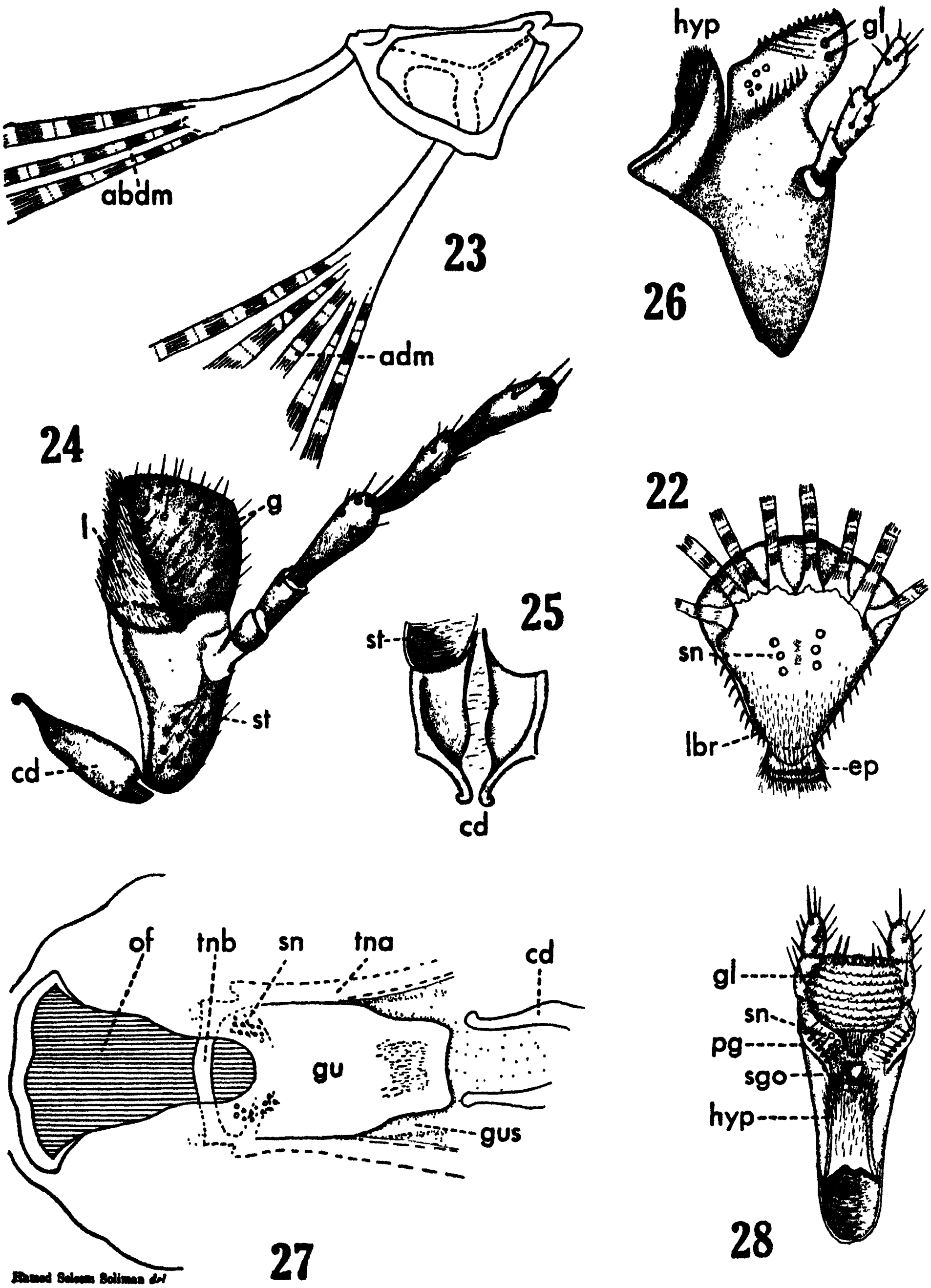
Fig. 26. — Labium (lateral aspect) : *gl*, glossa ; *hyp*, hypopharynx. — × 188.

Fig. 27. — Occipital foramen and area round it, to show gula : *cd*, cardo : *gu*, gula ; *gus*, gular suture ; *of*, occipital foramen ; *sn*, sensillae ; *tna*, tentorial anterior arm seen through chitin ; *tnb*, tentorial body seen through occiptal foramen. — × 240.

Fig. 28. — Labium (dorsal aspect) : *gl*, glossa ; *hyp*, hypopharynx ; *pg*, paraglossa ; *sn*, sensillae ; *sgo*, opening of salivary duct. — × 188.

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Plate IV



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Explanation of Plate V

Fig. 29. — Male and female antennae; *pd*, pedicel; *sc*, scape; *tcz*, testaceous coloured zone. — × 44.

Fig. 30. — Schematic cross-section in first flagellar segment of female's left antenna showing dorso-lateral sector (thin walled) devoid of rhinaria. — Enlarged.

Fig. 31. — Longitudinal section in head passing through basis of antenna: *anl*, antennal lobe of brain; *annv*, antennal nerve; *ansc*, antennal sclerite; *cly*, clypeus; *fc*, fat cells; *lbr*, labrum; *rd*, radicle; *tna*, tentorium anterior arm (the section does not pass through the whole length of the tentorial arm). — × 176.

Fig. 32. — Cross-section in an antennal segment not passing through the placoid sensillae: *bv*, blood vessel; *e*, reflected edge of rhinarium; *hyp*, hypodermis; *m*, membrane; *nv*, nerve; *rh*, rhinarium; *tr*, trachea; *tsn*, trichoid sensilla. — × 640.

Fig. 33. — Articulation of antenna with head: *ansc*, antennal sclerite; *chp*, chitinous pivot; *rd*, radicle; *sc*, scape. — × 60.

Fig. 34. — Cross-section passing through placoid sensilla of advanced pupa: *ts*, terminal strand; *vc*, vacule (sense cells send processes into vacule). — × 640.

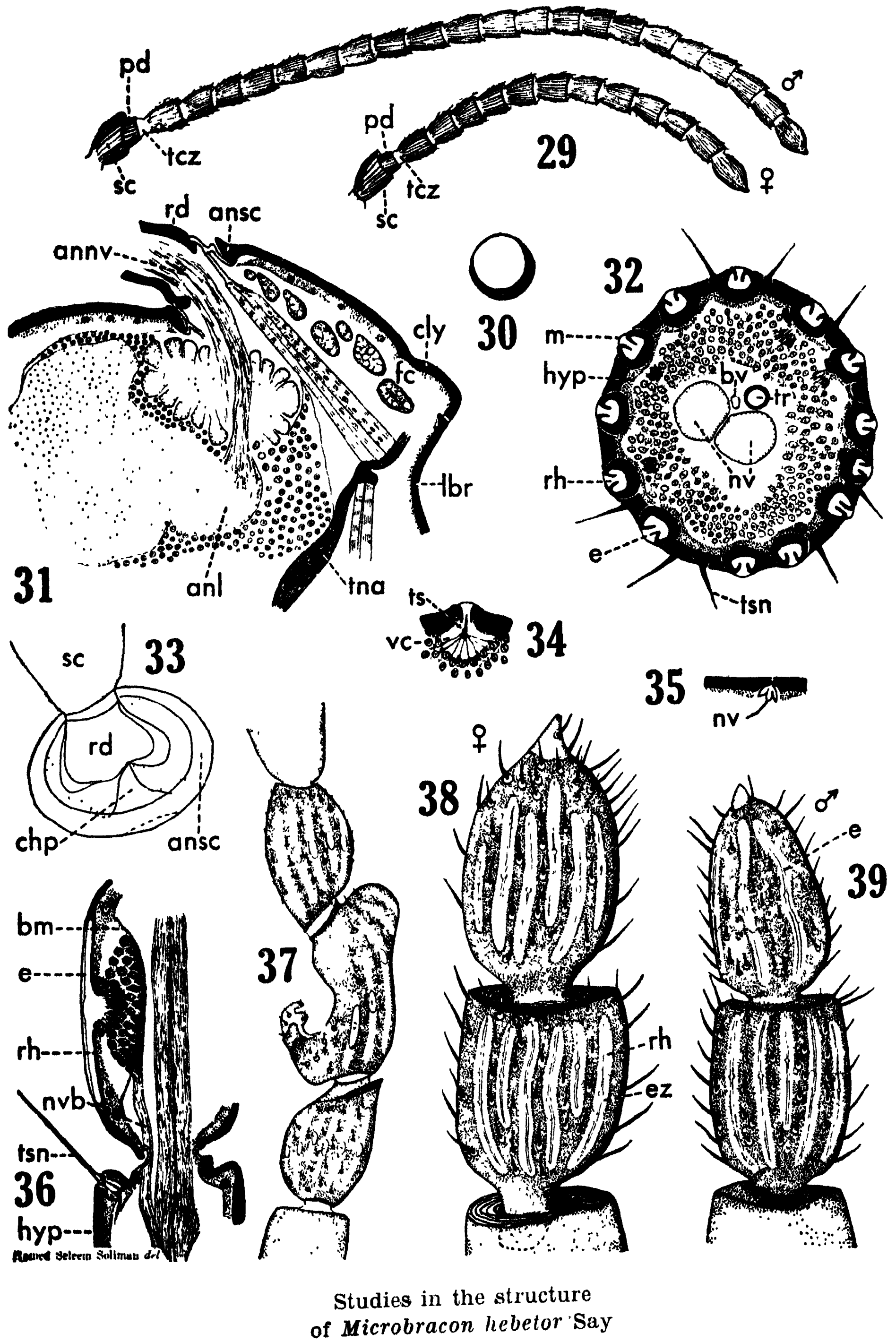
Fig. 35. — Longitudinal section in area between rhinaria showing coeloconic sensilla: *nv*, nerve. — × 640.

Fig. 36. — Longitudinal section passing through two parts of adjacent antennal segments and through a rhinarium: *bm*, basement membrane; *e*, reflected edge of rhinarium; *hyp*, hypodermis; *nvb*, branch of nerve innervating placoid sensilla; *rh*, rhinarium; *tsn*, trichoid sensilla. — × 640.

Fig. 37. — Part of male antenna showing deformation in three segments (the rhinaria on the proximal and distal segments are not inserted). — × 176.

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Plate V



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Explanation of Plate V (continuation)

Fig. 38. — Tip of a female's antenna : *rh*, rhinarium ; *cz*, elliptical zone where the chitinous basis of the rhinarium is missing, and where the internal elements of the placoid sensilla communicate with the external elements. — × 344.

Fig. 39. — Tip of a male's antenna : *e*, reflected edge of rhinarium seen through membrane. — × 344.

Explanation of Plate VI

Fig. 40. — Lateral aspect of thorax : *apr*, anterior parapteron or basalare plate; *cx1*, *cx2* and *cx3* pro-, meso- and metacoxae; *epm2*, mesothoracic epimeron; *eps1* and *eps2*, pro- and meso-episterna; *k* scuto-scutellar suture; *n1*, *n2* and *n3*, pro-, meso- and metanotum; *pl3*, metathoracic pleura; *pla*, mesopleural arm seen through integument; *plp*, pleural process; *prp*, posterior parapteron or subalare plate; *preps*, pre-episternum of mesothorax; *sctl2*, scutellum of mesothorax; *sp*, spiracle; *teg*, tegula; *z*, episternal division; *I*, *II* and *III*, first, second and third abdominal terga. — × 62.5.

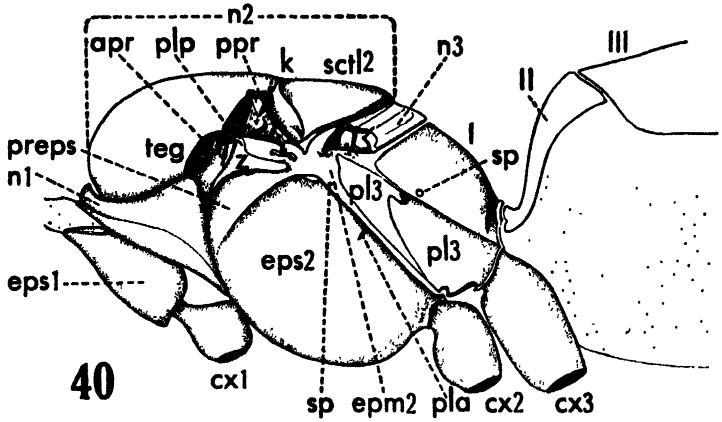
Fig. 41. — Ventral aspect of thorax: *cxc1*, *cxc2* and *cxc3*, pro-, meso-, and metacoxal cavities; *eps1*, pro-episternum; *n1*, pronotum; *oc*, occipital process; *ph1*, anterior mesophragma; *preps*, pre-episternum of mesothorax; *s1*, *s2* and *s3*, pro-, meso- and metasterna; *I*, first abdominal tergum seen from inside. — × 62.5.

Fig. 42. — Dorsal aspect of thorax : *awp*, anterior wing process; *axc*, axillary cord; *h*, faint suture; *j*, border of the area of attachment of dorsoventral indirect wing muscles; *k*, scuto-scutellar suture; *n3*, metanotum; *pn2*, meso-postnotum seen inside; *pwp*, posterior wing process; *q*, border of area of attachment of median longitudinal indirect wing muscles; *sctl2*, scutellum of mesothorax; *sp*, spiracle; *teg*, tegula; *I*, first abdominal tergum. — × 62.5.

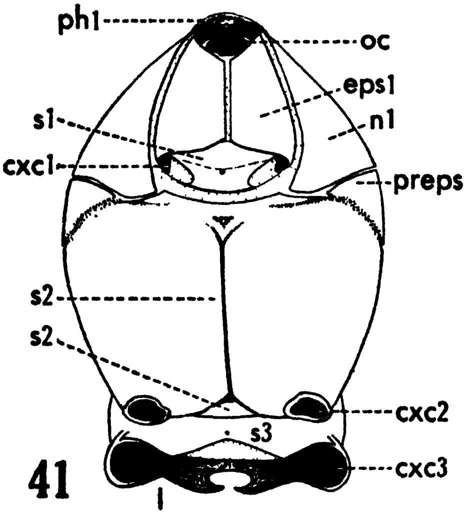
Fig. 43. — Mesopostnotum dissected out with the posterior mesophragma: *ph2*, mesophragma; *pn2*, mesopostnotum; *w*, lateral anterior coner of mesophragma. — × 62.5.

Fig. 44. — Pronotum (inside aspect looked at from posterior: *sp*, first thoracic spiracle. — × 62.5.

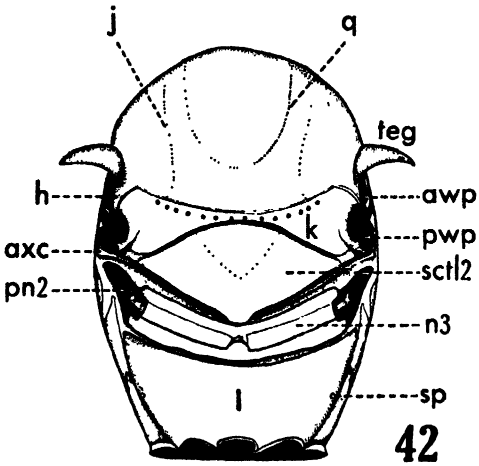
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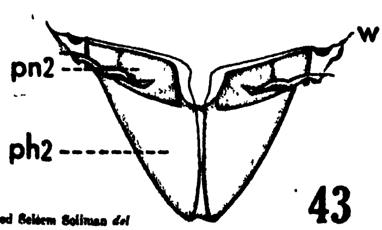
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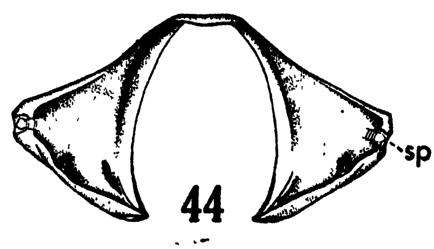


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Explanation of Plate VII

Fig. 45. — Posternum dissected out (ventral aspect) : *a*, prosternal arm ; *f1p*, profurcal pit ; *spe*, posterior edge of prosternum. — × 172.

Fig. 46. — Metasternum dissected with posterior part of mesosternum, and with basis of the first abdominal segment which was cut laterally and turned over to show the coxal cavity end view : *cxc2* and *cxc3*, coxal cavities of meso- and metathoracic legs ; *fp*, furcal pits, *s2* and *s3*, meso- and metasterna ; *I*, first abdominal segment. — × 60.

Fig. 47. — Profurca dissected out with prosternum (anterior aspect) : *fa*, furcal arm ; *fs*, furcal stem ; *s1*, prosternum ; *spe*, posterior edge of prosternum seen behind the furca. — × 100.

Fig. 48. — The inside of propectus (dorsal view) : *a*, prosternal arm ; *eps*, episternum ; *fa*, furcal arm ; *m*, folded cuticle ; *os*, occipital process ; *s1*, prosternum ; *x*, chitinous process ; *y*, faintly scleritised area. — × 100.

Fig. 49. — Propectus (lateral aspect) : *a*, prosternal arm ; *cxc1*, procoxal cavity ; *eps*, episternum ; *fa*, furcal arm ; *fs*, furcal stem ; *os*, occipital process ; *s1* prosternum ; *x*, chitinous process ; *y*, faintly scleritised area. — × 96.

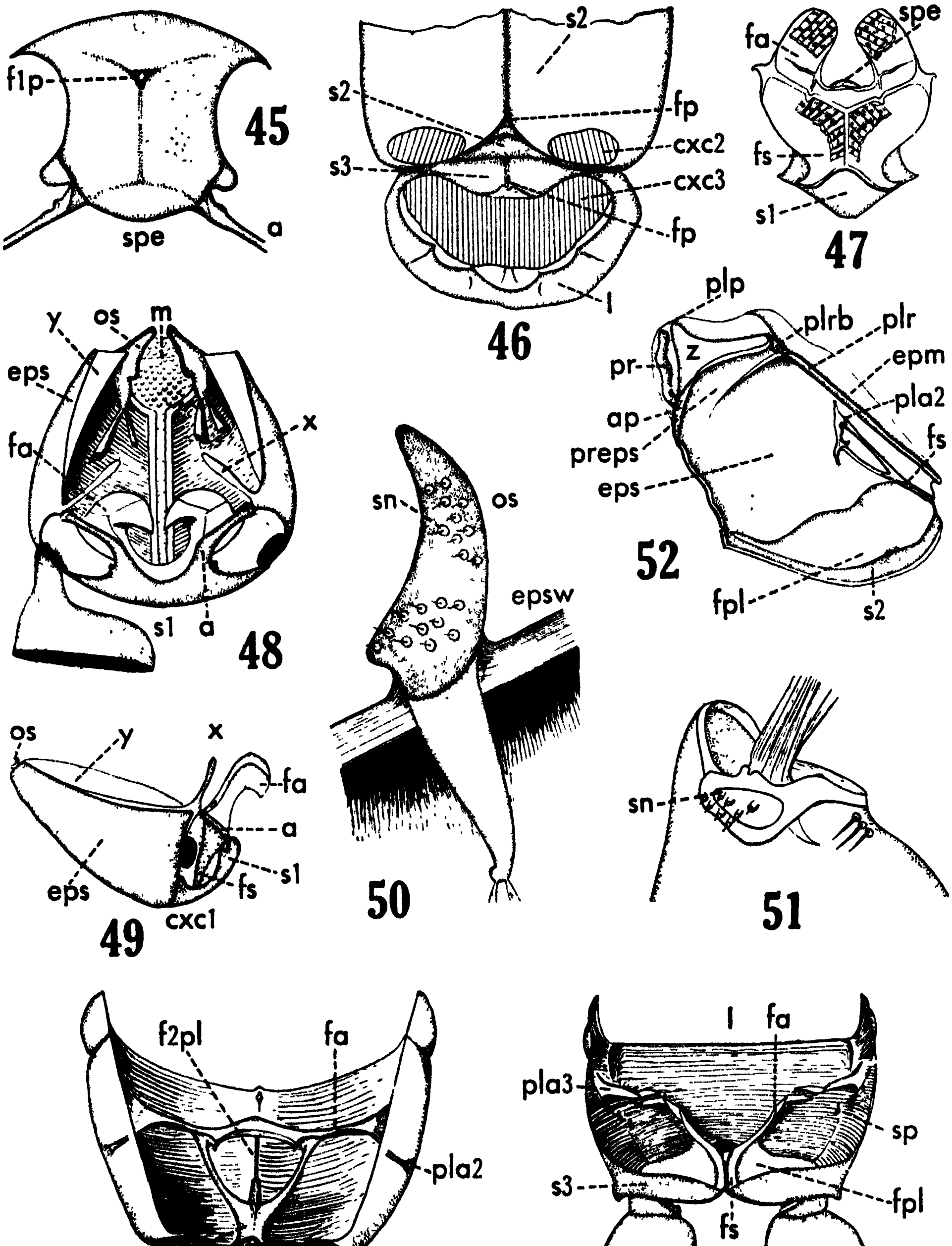
Fig. 50. — Right occipital process of female dissected out with a piece of pro-episternum (inside aspect, sensillae seen through) : *epsw*, anterior episternal edge ; *oc*, occipital process ; *sn*, sensilla. — × 652

Fig. 51. — Basal part of metacoxa showing sensillae on meron : *sn*, sensillae. — × 240.

Fig. 52. — Right episternum and pleuron (inside aspect) : *ap*, pronator disc (this plate is connected to the anterior paraptera with the scleritised prolongation *pr*) ; *fpl*, mesofurcal plate ; *1fs*, stem of mesofurca ; *epm*, epimeron ; *eps*, episternum ; *pla2*, pleural arm of mesothorax ; *plp*. mesopleural process ; *plr*, pleural ridge ; *plrb*, connection showing the continuation of the pleural ridge (this connection does not appear externally in the pleural suture [Plate VI, figure 40]) ; *pr*, scleritised prolongation between the pronator disc and the anterior paraptera ; *preps*, pre-episternum ; *s2*, mesosternum ; *z*, mesopleural tertiary division. — × 61.5.

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Plate VII



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Explanation of Plate VII (continuation)

Fig. 53. — Mesopectus from inside (dorsal aspect) : *fa*, furcal arm ; *fp*, furcal pit ; *f2pl* (= *fpl* of figure 52), mesofurcal plate ; *fs*, stem of mesofurca ; *pla2*, pleural arm seen through pleura. — × 61.5.

Fig. 54. — Sternum and pleuron of metathorax dissected out and looked at from inside (anterior ventral aspect to show metafurca, and first abdominal tergum also shown from inside) : *fa*, furcal arm ; *fpl*, metafurcal plate ; *fs*, stem of metafurca ; *pla3*, metapleural arm ; *s3*, reflexed anterior edge of metasternum ; *sp*, spiracle of first abdominal tergum seen from inside ; *I*, first abdominal tergum. — × 61.5.

Explanation of Plate VIII

Fig. 55. — Cross-section in thorax just anterior to forewing: *ao*, aorta; *dm*. direct wing muscles; *idv*, indirect dorso-ventral muscles; *imp*, indirect median dorsal muscles; *pm*, pronator muscles; *tr*, trachea. — × 60.

Fig. 56. — Area round stigma of anterior wing to show sensillae *sn*. — × 61.5.

Fig. 57. — Base of hind wing : *1ax*, *2ax*, and *3ax*, first, second and third axillary sclerites; *md*, median plate of wing base; *p*, basis of subcosta. — × 27.5.

Fig. 58. — Base of fore wing : *1ax*, *2ax* and *3ax*, first, second and third axillary sclerites; *md*, median plate of wing base; *p*, basis of subcosta; *sn*, group of sensory hairs. — × 27.5.

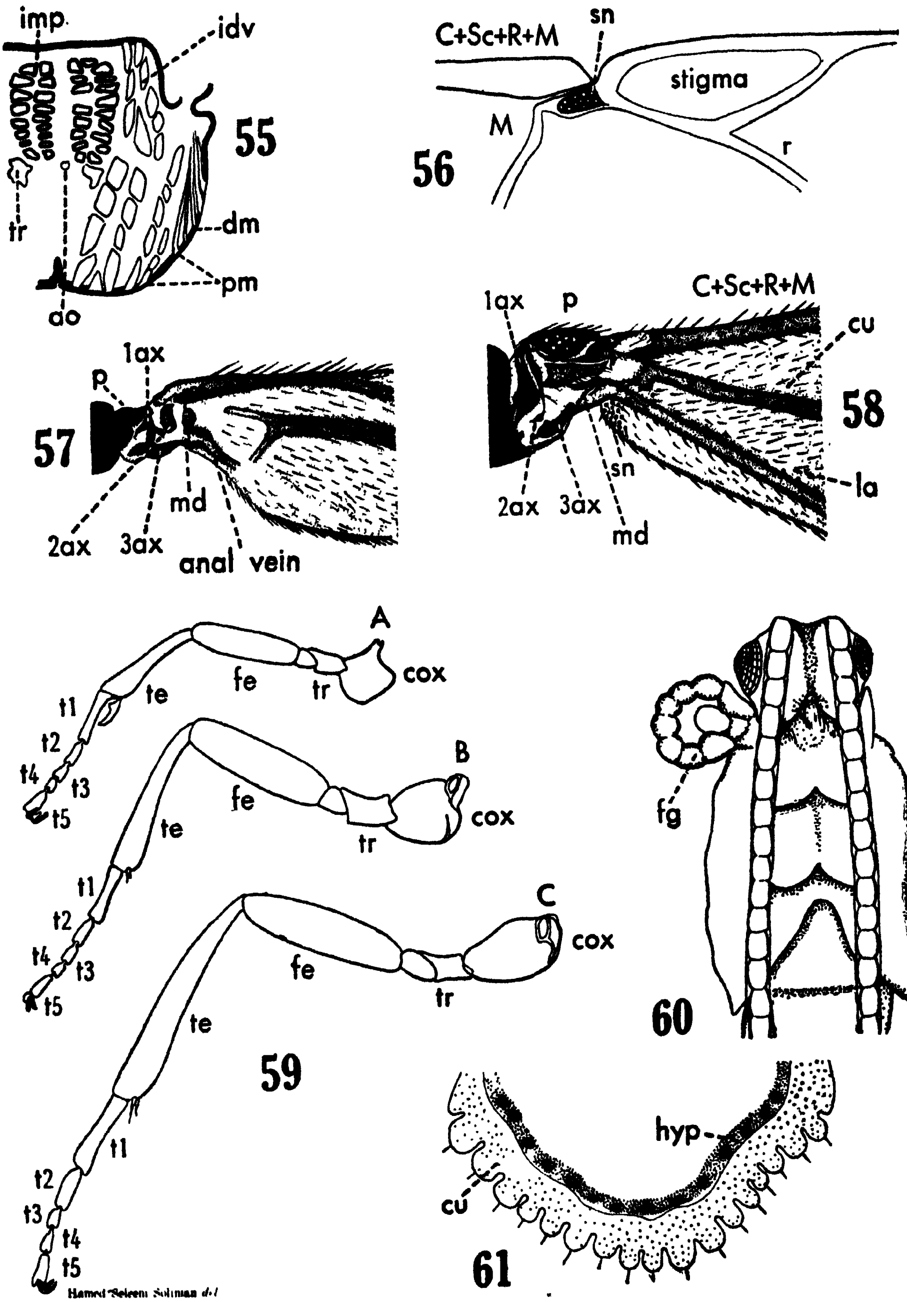
Fig. 59. — *A*, *B*, and *C*, anterior, mid and hind left legs : *cox*, coxa; *fe*, femur; *te*, tibia; *tr*, trochanter; *t1*, *t2*, *t3*, *t4* and *t5*, tarsal segments — × 100.

Fig. 60. — Male prepupa (ventral aspect) showing teratology in right proleg : *fg*, deformed proleg. — × 40.

Fig. 61. — Cross-section through non scleritised cuticle found in neck and between pro- and mesopectus : *cu*, cuticle; *hyp*, hypodermis. — × 640.

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Plate VIII



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Explanation of Plate IX

Fig. 62. — Pretarsus (lateral aspect) : *ar*, arolium ; *br*, bristle on claw ; *bw*, bow of arolium ; *cal*, calcanea ; *cl*, claw ; *ed*, scleritised edge of last tarsal segment ; *fl*, gleitflache ; *orb*, orbicula ; *pl*, planta ; *tn*, tendon ; *ung*, unguifer. — × 640.

Fig. 63. — Pretarsus (dorsal aspect) : *ar*, arolium ; *bw*, bow of arolium ; *cl*, claw ; *cs*, campaniform sensilla ; *orb*, orbicula ; *ung*, unguifer. — × 640.

Fig. 64. — Pretarsus (ventral view) : *ar*, arolium ; *bw*, bow of arolium ; *cal*, calcanea. — × 640.

Fig. 65. — Cross-section in pretarsus passing through the planta : *ar*, arolium ; *cl*, claw ; *orb*, orbicula ; *pl*, planta. — × 640.

Fig. 66. — Cross-section in pretarsus passing through opening of claws into adhesive organ (the section is somewhat slanting) : *cal*, calcanea ; *cl*, claw ; *lpd*, latero dorsal process of claw ; *nv*, nerve ; *orb*, orbicula ; *tr*, trachea. — × 640.

Fig. 67. — Dorsal aspect of pretarsus showing arolium half open : *ar*, arolium ; *bw*, bow of arolium ; *cl*, claw ; *cs*, campaniform sensilla ; *ldp*, latero dorsal process of claw ; *orb*, orbicula. — × 640.

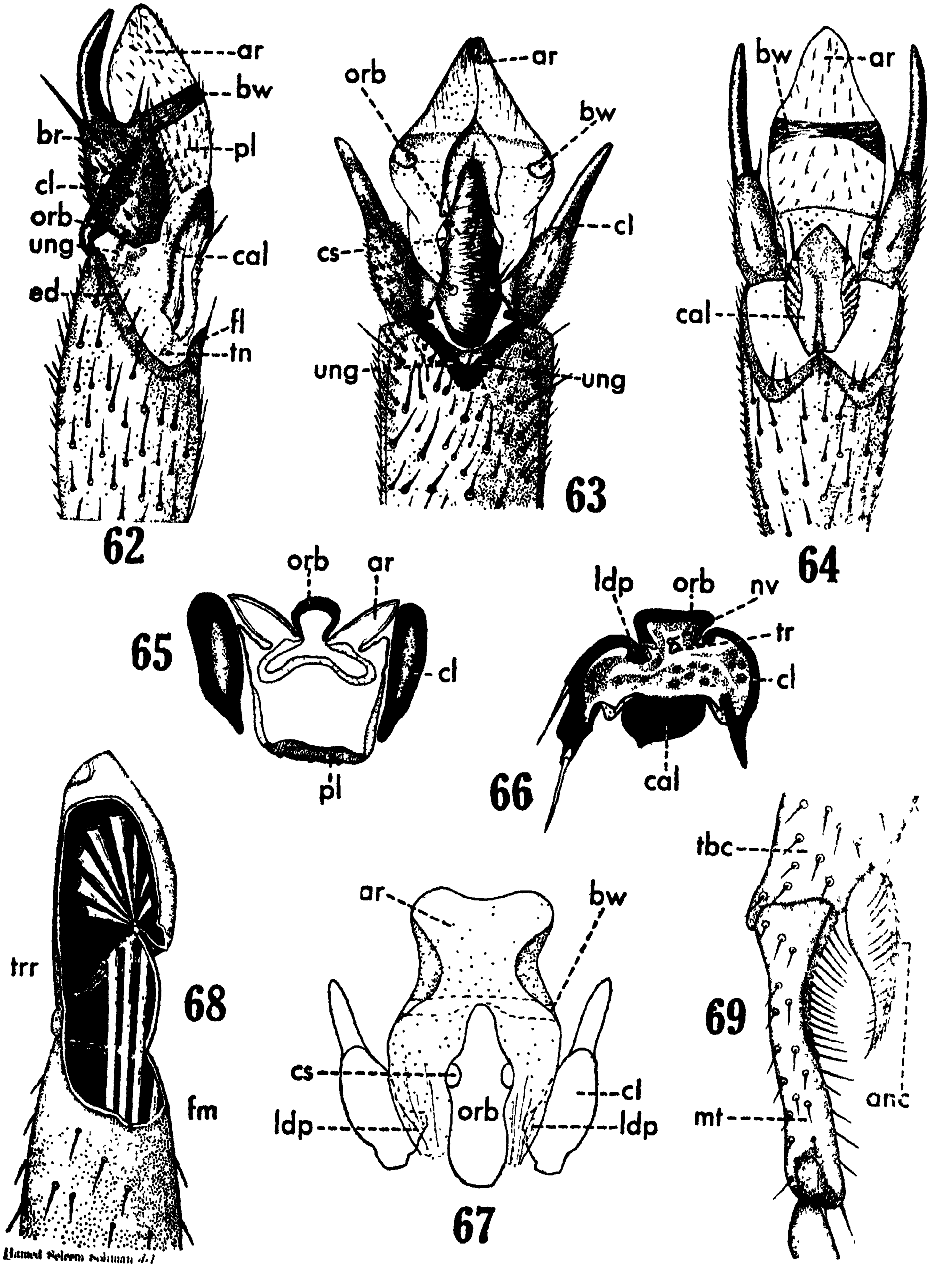
Fig. 68. — Trochanter and base of femur cut open : *fm*, femur ; *trr*, trochanter (the fan-shaped muscles are some of the reductor femories, the other muscles are the tibial flexor : both muscles are attached to the real base of the femur showing that the « second trochanter » is morphologically a part of the femur). — × 160.

Fig. 69. — Distal end of tibia and metatarsus of anterior leg showing antenna-cleaner formed by the modified tibial spur *anc* and the curved metatarsus *mt* ; *tbc*, tibia. — × 244.

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Plate IX



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Explanation of Plate X

Fig. 70. — Female's abdomen (lateral aspect) : *gd*, palps or guides of ovipositor and sting; *sp*, spiracle; *stn*, sternite; *II* and *VII*, second and seventh abdominal terga. — × 31.

Fig. 71. — Longitudinal section in posterior end of male's abdomen showing eighth abdominal gland *gl*; *a*, anus; *VII* and *VIII*, seventh and eighth abdominal terga. — × 168.

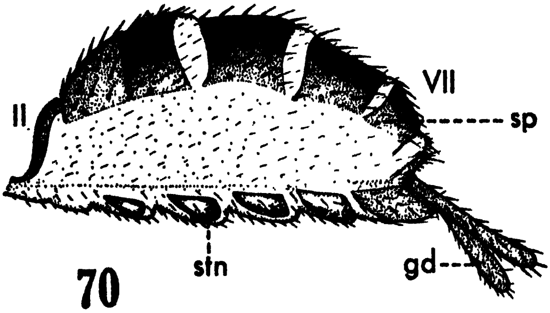
Fig. 72. — Second and part of the third abdominal terga (dorsal aspect) : *k*, suture; *sp*, spiracle; *II* and *III*, second and third abdominal terga; *IIt*, anterior part of second abdominal tergum. — × 68.

Fig. 73. — Male's abdomen (lateral aspect) : *stn*, sternite; *VII*, seventh abdominal terga. — × 29.5.

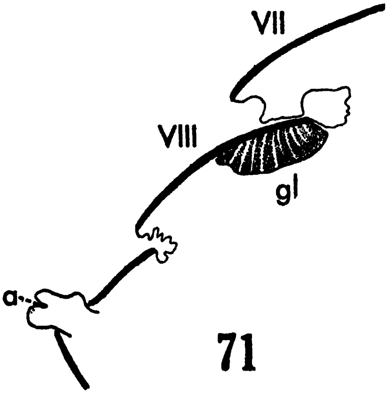
Fig. 74. — Drawing of anterior of gaster dissected and spread flat on the slide (anterior aspect) : *k*, suture; *sn*, sensillae; *Is*, first abdominal sternum (ventral aspect) ; *II*, second abdominal terga; *IIs*, second abdominal sternum ; *IIt*, anterior part of second abdominal tergum. — × 240.

Fig. 75. — Magnified anterior part of male's eighth abdominal gland : *ism*, intersegmental membrane; *nu*, nucleus of glandular cell; *VIII*, eight abdominal terga. — × 640.

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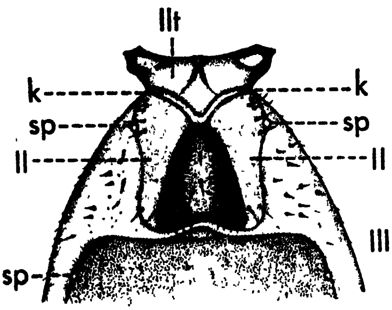
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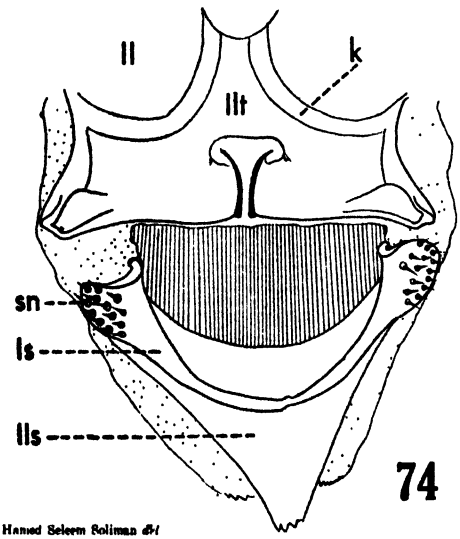
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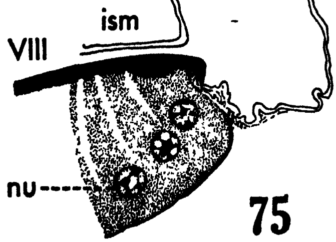
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Explanation of Plate XI

Fig. 76. — Posterior part of female's abdomen, last segments pulled out (lateral aspect) : *a*, anus; *cr*, cercus; *gd*, palp-like processes, or guides of ovipositor; *op*, oblong plate; *qp*, quadrate plate; *sth*, stylets and their sheath; *tp*, triangular plate; *VIII* and *IX*, eighth and ninth terga; *Xs*, tenth sternum. — × 60.

Fig. 77. — Posterior part of female's abdomen (end view) : *a*, anus; *cr*, cercus; *sp*, spiracle; *VIII* and *IX*, eighth and ninth terga; *Xs*, tenth sternum. — × 58.5.

Fig. 78. — Ovipositor (ventral aspect) : *cr*, cercus; *gd*, palp-like processes; *op*, oblong plate; *or*, scleritised rib in inner or oblong plate; *qp*, quadrate plate; *qr*, scleritised rib in outer or quadrate plate; *sn*, sensillae; *shb*, sheath bulb; *sth*, stylets and their sheath; *tp*, triangular plate; *u*, scleritised rib on outer edge of oblong plate; *IX*, ninth terga. — × 96.

Fig. 79. — Tip of stylet sheath : *sn*, sensillae. — × 640.

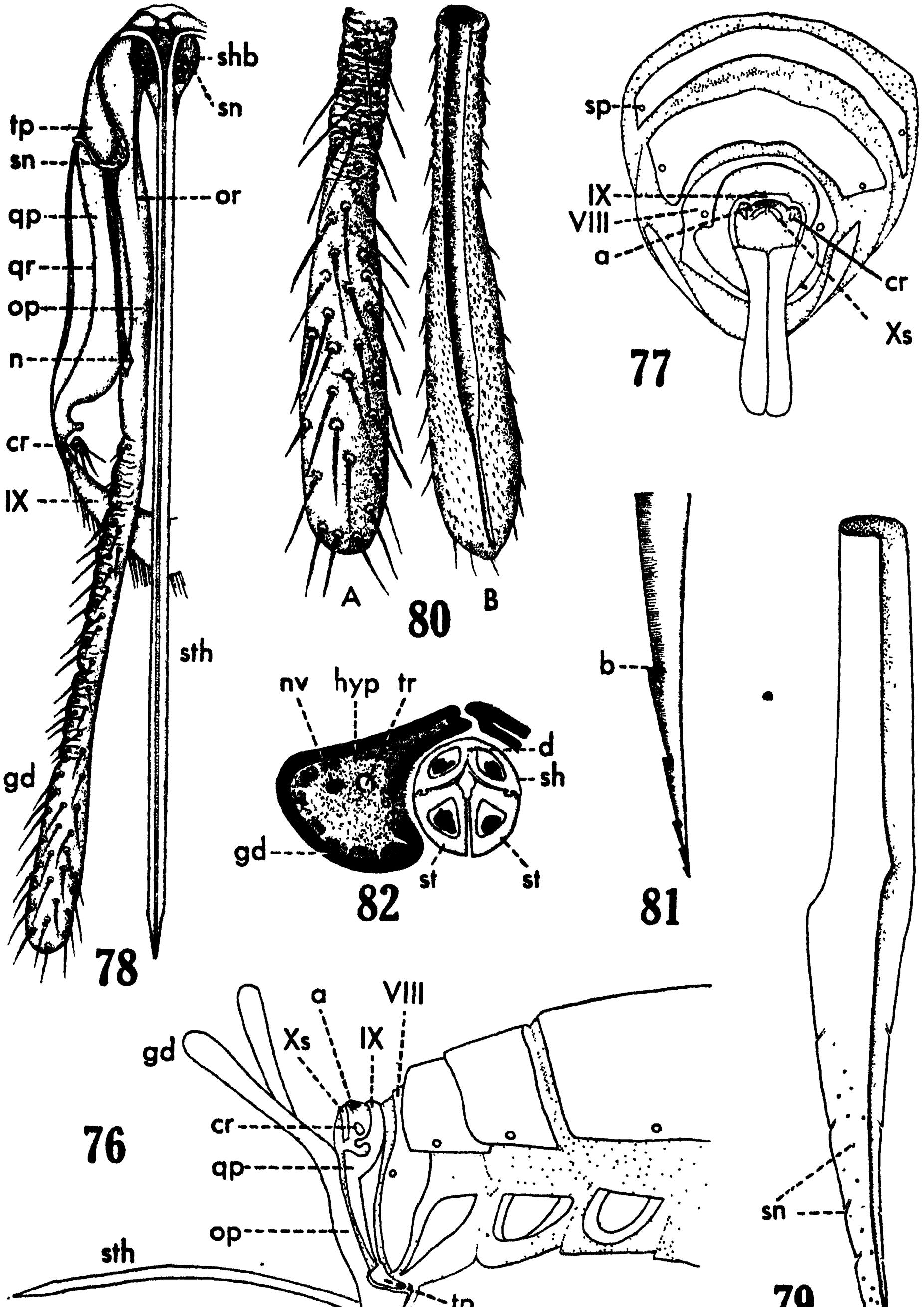
Fig. 80. — Tip of guides of ovipositor : *A*, outer side; *B*, inner side, showing groove. — × 304.

Fig. 81. — Tip of right stylet (ventral aspect) : *b*, first barb. — × 640.

Fig. 82. — Cross-section in ovipositior at a level just before the folded part of the guides *gd* (Fig. 78) : *d*, partition in the stylet sheath; *gd*, guides or palp-like appendages; *hyp*, hypodermis; *nv*, nerve; *sh*, stylet sheath; *st*, stylets; *tr*, trachea. — × 640.

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Plate XI



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Explanation of Plate XII

Fig. 83. — Median longitudinal section in head: *cly*, clypeus; *ep*, epipharynx; *gu*, gula; *hyp*, hypopharynx underwhich runs the common duct of the salivary glands; *lbm*, labium; *lbr*, labrum; *md*, mandible (section passes through the top of the mandible); *oes*, oesophagus; *tnb*, tentorial body. — × 96.

Fig. 84. — Pharyngeal plate dissected out (dorsal aspect) : *a*, arm; *sn*, sensillae (its anterior end points towards the top of the page). — × 96.

Fig. 85. — Cross-section through oesophagus showing longitudinal muscles *lm*, and circular muscles (epithelium thrown into folds). — × 640.

Fig. 86. — Longitudinal section through proventriculus : *cr*, crop; *prv.*, proventriculus; *vn*, ventriculus. — × 164.

Fig. 87. — Cross-section through proventriculus : *cm*, circular muscles; *lm*, longitudinal muscles. — × 640.

Fig. 88. — Dissection of adult drawn from left side : *ap*, pronator disc; *ht*, heart; *idm*, interior direct wing muscles; *imp*, indirect median dorsal muscles; *k*, scuto-scutella suture; *nr*, notal ridge; *ph1* and *ph2*, mesothoracic phragma; *pr*, scleritised prolongation connected to anterior parapteron. -- × 46.5.

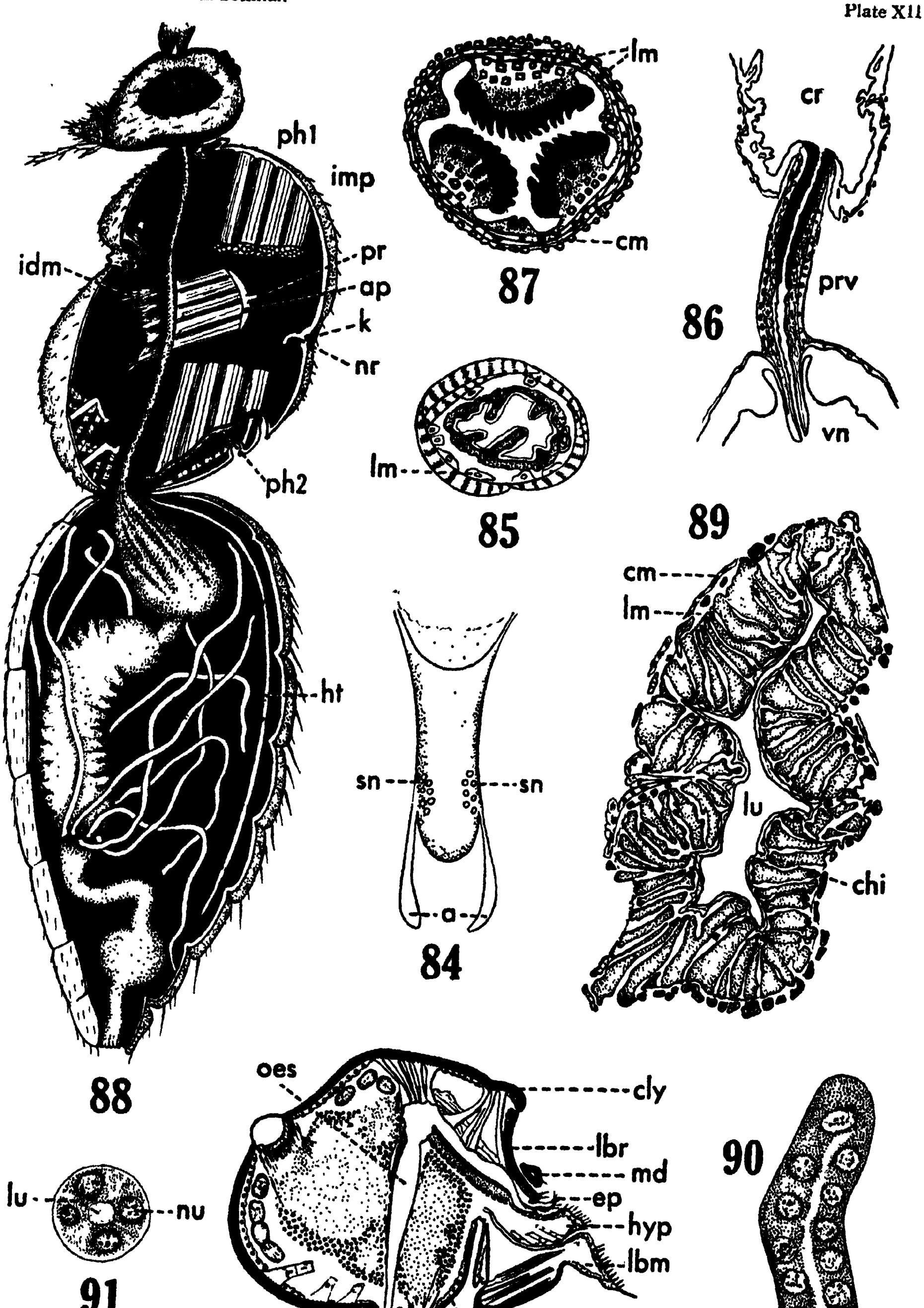
Fig. 89. — Cross-section through crop : *chi*, chitinous interna; *cm*, circular muscles; *lm*, longitudinal muscles; *lu*, lumen. — × 400.

Fig. 90. — Longitudinal section in malpighian tube. — × 640.

Fig. 91. — Cross-section in malpighian tube : *lu*, lumen; *nu*, nucleus. — × 640.

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Plate XII



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Explanation of Plate XIII

Fig. 92. — Cross-section in pharynx showing the pharyngeal plate *php* and the greatly developed layer of cells under this plate (the section does not pass through the area where sensillae *sn* (Plate XII, fig. 84) are situated but is anterior to it. — × 640.

Fig. 93. — Cross-section in the pharyngeal plate passing through one of the sensillae: *nv*, nerve innervating the sensilla which has a thin dome-like covering membrane; *sn*, sensilla. — × 656.

Fig. 94. — Cross-section in ventriculus showing the darkly stained nidi or regenerating cells : *cm*, circular muscles; *epc*, epithelial cells of ventriculus; *lm*, longitudinal muscles; *nc*, nidi cell; *sh*, striated hem. — × 640.

Fig. 95. — Longitudinal section in junction of ventriculus and hind gut : *cm*, circular muscles; *chi*, chitinous intima lining hind gut; *hg*, hind gut; *lm*, longitudinal muscles; *mt*, malpighian tube; *pm*, periotrophic membrane; *omt*, opening of malpighian tube between ventriculus and hind gut; *vn*, ventriculus. — × 640.

Fig. 96. — Cross-section in rectum : *axc*, axial cavity; *rcp*, rectal pad. — × 240.

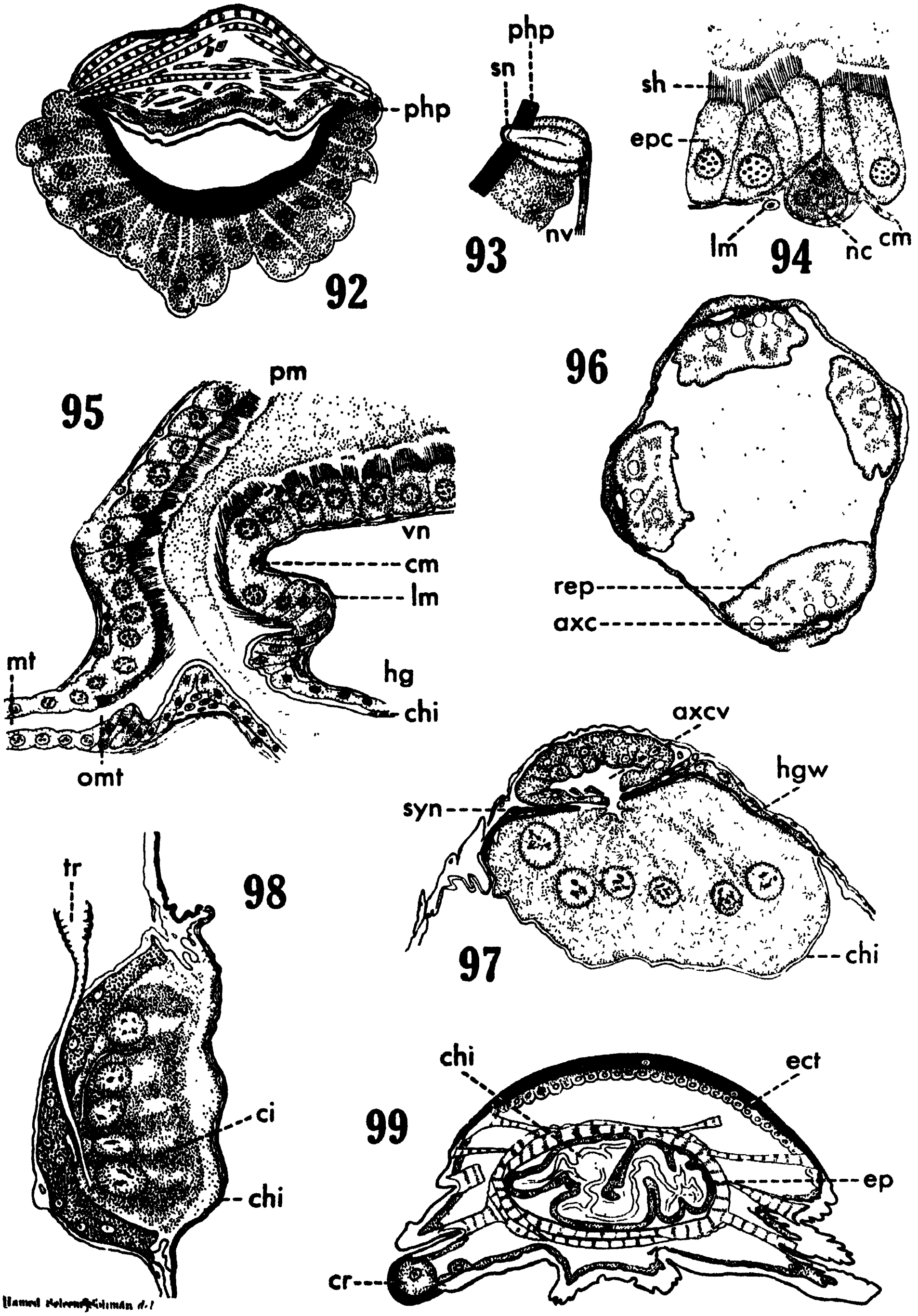
Fig. 97. — Cross-section in one of rectal pads : *axcv*, axial cavity ;.*chi*, chitinous intima; *hgw*, wall of hind gut; *syn*, syncytium. — × 640.

Fig. 98. — Longitudinal section through a rectal pad showing entrance of trachea : *chi*, chitinous intima lining the inside of the pad; *ci*, cell inclusions; *tr*, trachea. — × 640.

Fig. 99. — Slating cross-section near the anus showing the rectum behind the rectal gland : *chi*, chitinous intima; *cr*, cercus; *etc*, ectoderm or hypodermis; *ep*, epithelium of rectum. — × 440.

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Plate XIII



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Explanation of Plate XIV

Fig. 100. — Longitudinal section in « cardiac valve or invagination » : *bs*, blood sinus; *chi*, chitinous intima; *cm*, circular muscles; *ep*, epithelium of proventriculus; *lm*, longitudinal muscles; *sph*, sphincter muscle; *vn*, ventriculus. — × 640.

Fig. 101. — Longitudinal section in last abdominal ganglionic centre : *A*, female; *B*, male. — × 240.

Fig. 102. — Frontal section passing through side of the head : *c*, compound eye; *epo*, epiopticon; *opt*, opticon; *po*, periopticon. — × 168.

Fig. 103. — Abdominal spiracle (surface view, the anterior direction points towards the top of the page) : *bo*, stationary, chitinous hollow pocket; *lv*, lever; *o*, spiracular opening; *per*, peritreme. — × 440.

Fig. 104. — Inner aspect of spiracle (*A*, while it is open; *B*, while it is closed) : *bo*, stationary chitinous hollow pocket; *cp*, chitinous piece; *lv*, lever; *o*, spiracular opening; *och*, inner or occluding chamber; *om*, closing muscles; *opm*, opening muscles; *per*, peritreme; *tr*, trachea. — × 648.

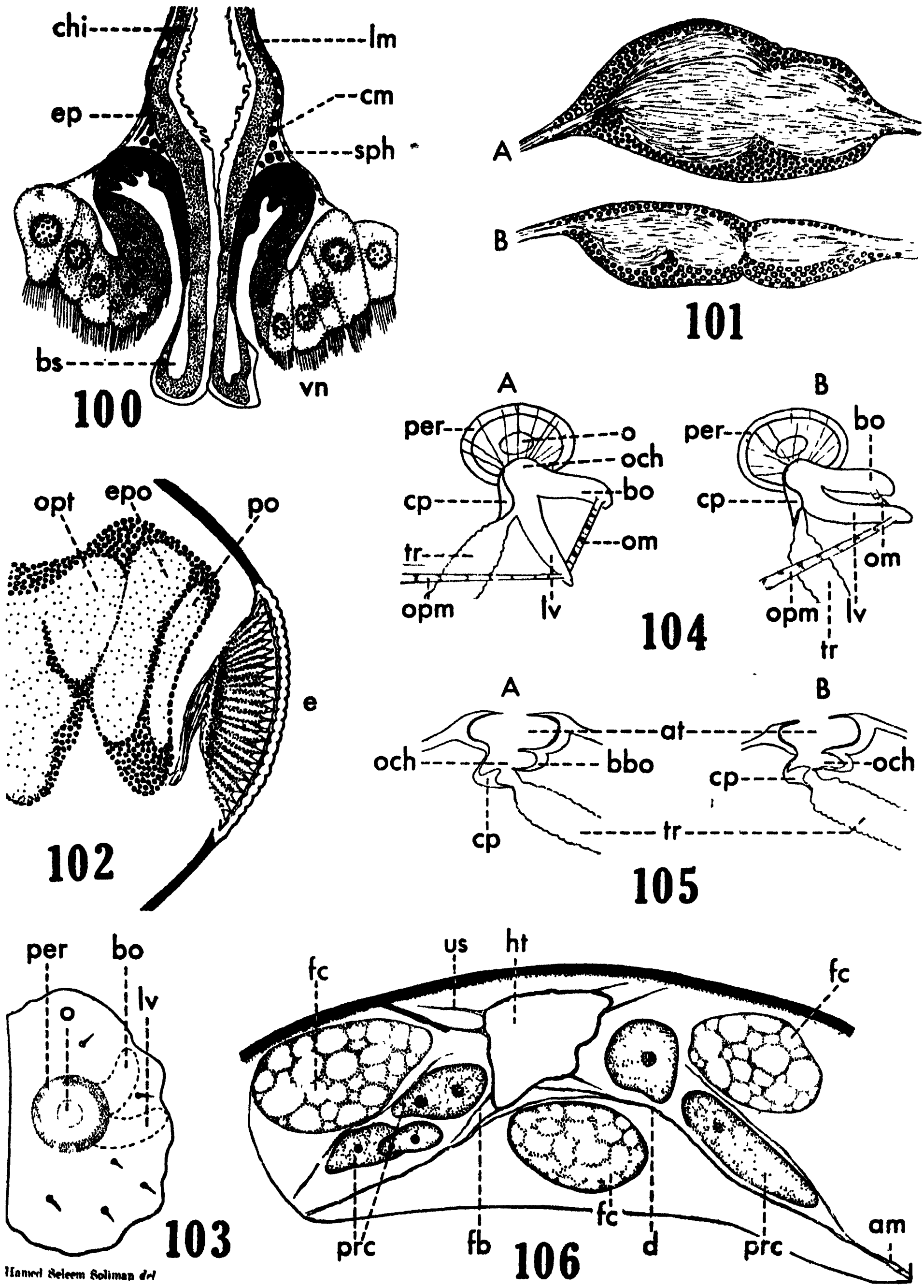
Fig. 105. — Longitudinal section in spiracle (*A*, open; *B*, closed) : *at*, outer chamber; *bbo*, basis of *bo* of Figure 104; *cp*, chitinous piece; *och*, inner or occluding chamber; *tr*, trachea. — × 640.

Fig. 106. — Cross-section in the heart at sixth tergum : *am*, alary muscles; *d*, diaphragm; *fb*, fibres from branches of alary muscles; *fc*, flat cells; *ht*, heart; *prc*, pericardial cells; *us*, suspensorium. — × 640.

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Plate XIV



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Explanation of Plate XV

Fig. 107. — Cross-section in the wall of accessory or mucous gland : ***cm***, circular muscles; ***epc***, tall epithelial cells; ***lm***, longitudinal muscles; *pc*, peritoneal coat; *sn*, secretion. — × 640.

Fig. 108. — Cross-section in accessory or mucous glands and vasa deferentia in their common peritoneal coat, just before the vasa deferentia open into the gland : *mg*, mucous gland; *pc*, peritoneal coat; *sn*, secretion; *vd*, vas deferens. — × 320.

Fig. 109. — Longitudinal section passing through the opening of vasa deferentia into the mucous gland : *mg*, mucous gland; *v*, lip or valve which closes the opening of the vas deferens; *vd*, vas deferens. — × 240.

Fig. 110. — Male reproductive system (lateral aspect). The valves of the genital armature of left side and left side of basal piece are cut off : *a*, anus; *bp*, basal piece; *cjd*, ejaculatory duct; *inv*, internal valve of left side; *invp*, process of internal valve; *mg*, mucous gland; *p*, penis; *pa*, genital aperture; *rc*, rectum; *t*, testes; *vd*, vasa deferentia. — × 120.

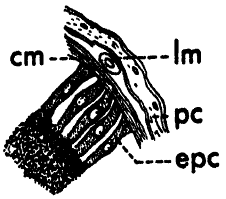
Fig. 111. — Male genital armature (ventral aspect) : *bp*, basal piece; *chs*, chitinous strut; *exv*, external valve; *inv*, internal valve; *invp*, process of internal valve; *p*, penis; *pk*, keel of penis; *sn*, sensillae; *sz*, scleritisation in wall of penis. — × 240.

Fig. 112. — Male reproductive system in situ and genital armature (dorsal aspect) : *bp*, basal piece; *ejd*, ejaculatory duct; *exv*, external valve; *inv*, internal valve; *invp*, process of internal valve; *p*, penis; *V*, *VI* and *VII*, fifth, sixth and seventh abdominal segments. — × 92.

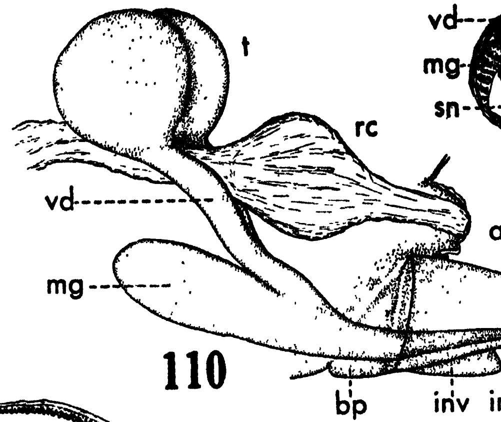
Fig. 113. — Cross-section in male genital armature passing at a level just anterior to the processes of the internal valve : *cjd*, ejaculatory duct; *exv*, external valve; *inv*, internal valve; *m*, membrane; *p*, penis; *pk*, keel of penis; *sz*, scleritisation in wall of penis. — × 232.

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Plate XV



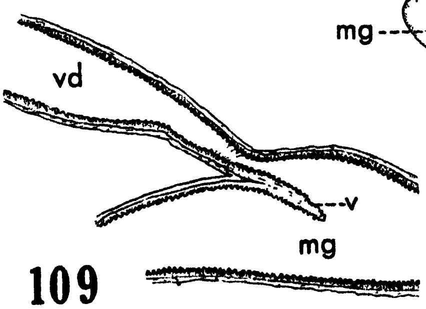
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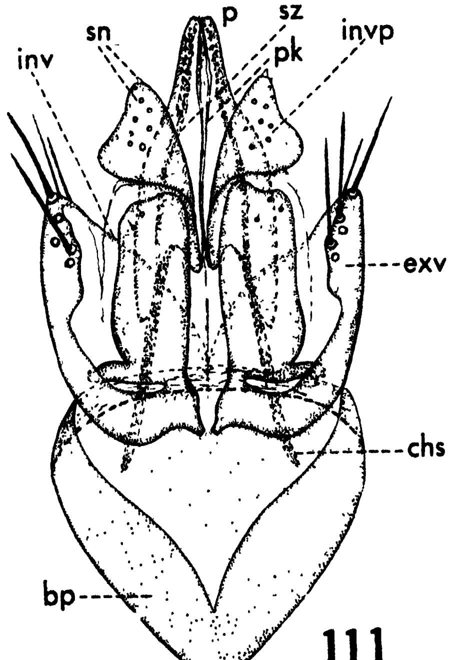
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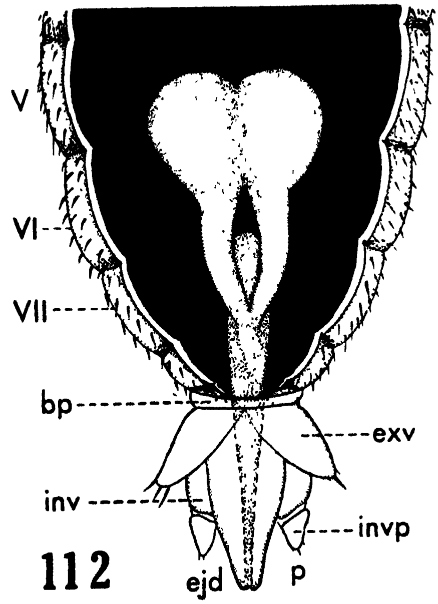
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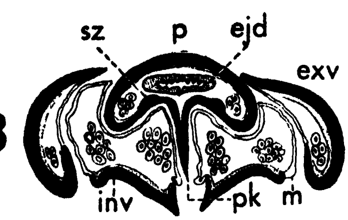
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Explanation of Plate XVI

Fig. 114. — Female reproductive system : *cx*, calyxes; *ovd*, oviducts; *spm*, spermatheca; *tf*, short terminal or apical region; *va*, vagina; *vt*, vitellarium. — × 50.

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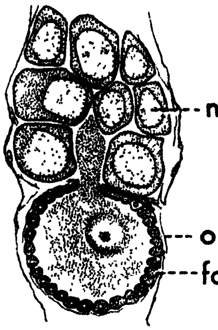
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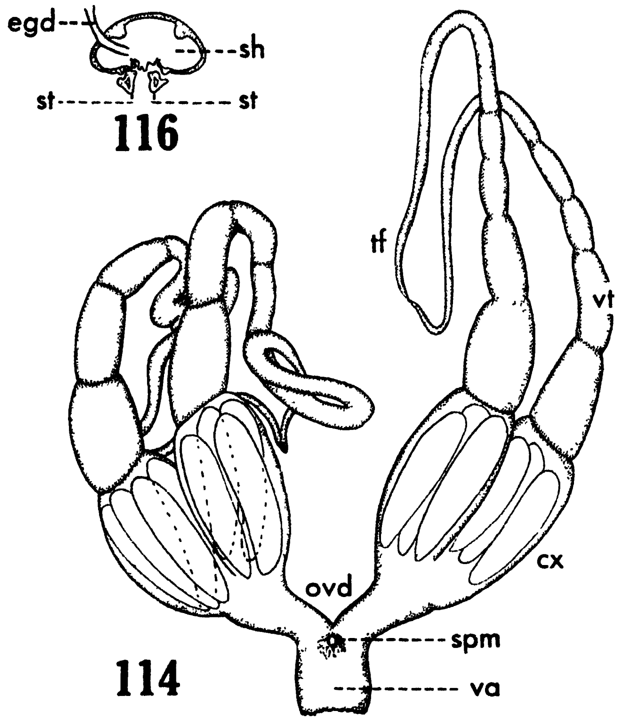
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Plate XVI

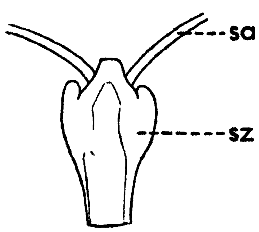


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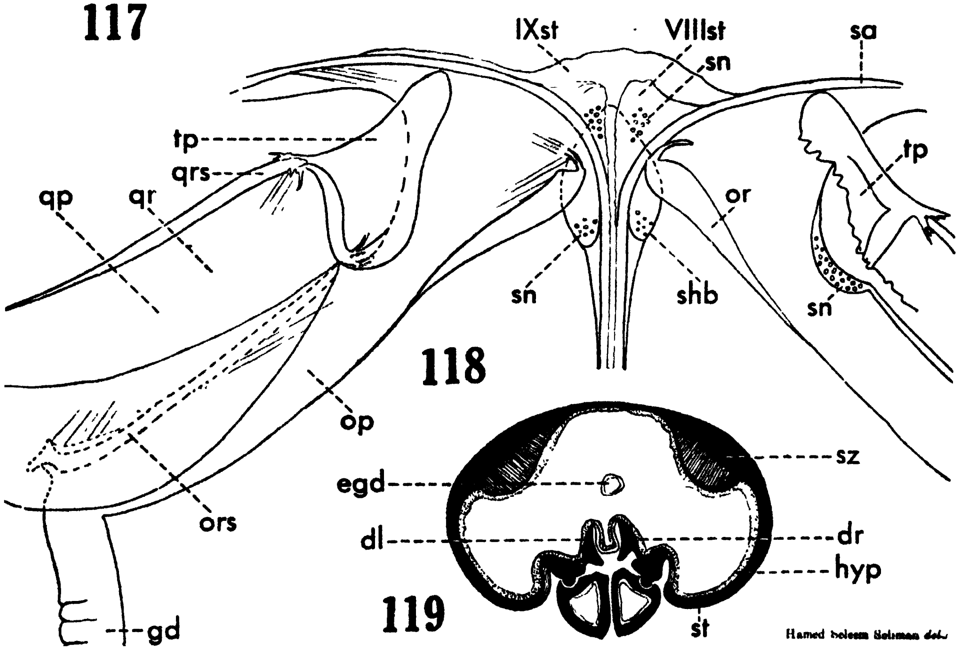


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Explanation of Plate XVII

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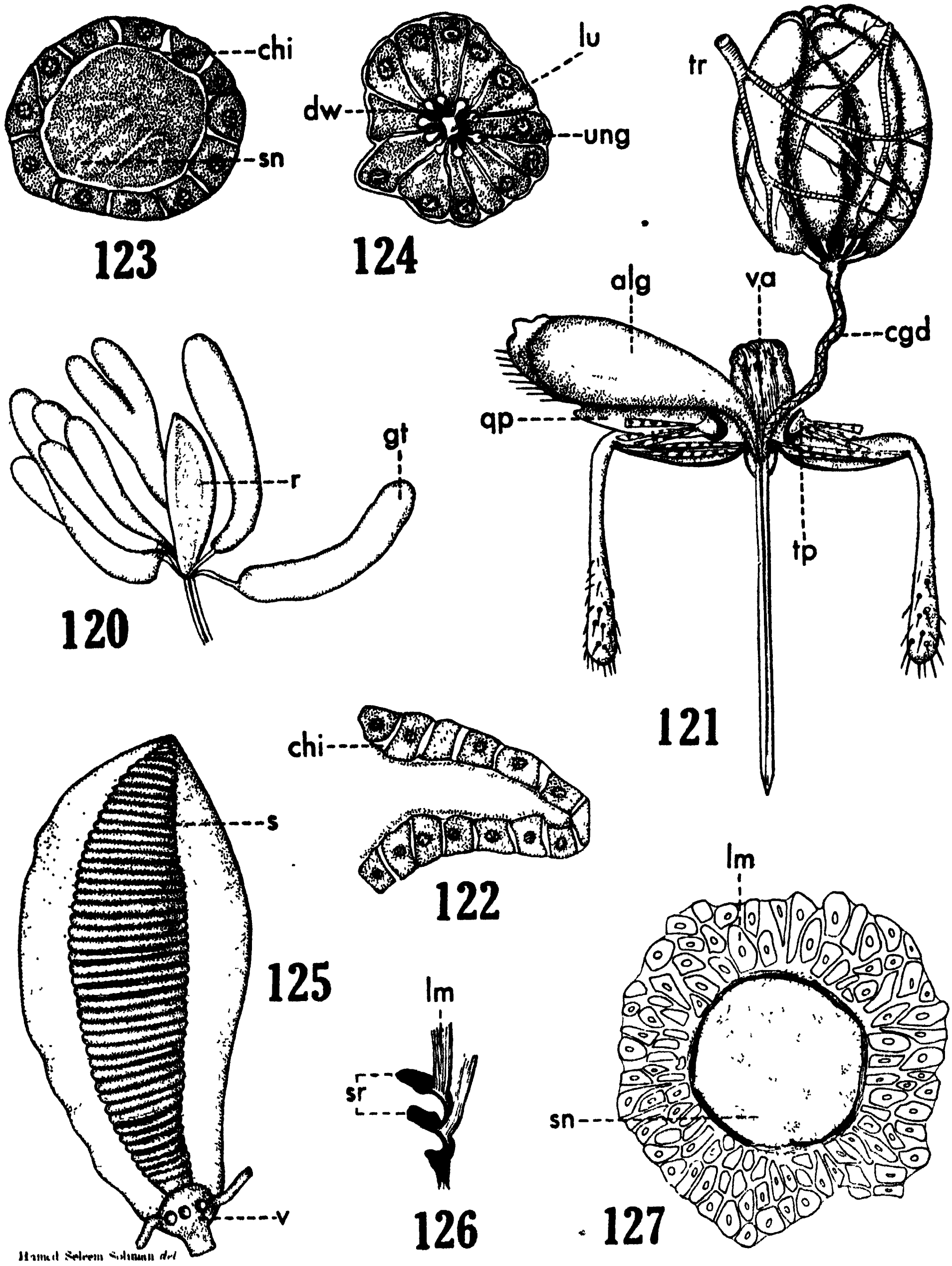
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BULL. SOC. FOUAD Ier ENT., XXV, 1941

Prof. Dr Hamid Seleem Soliman

Plate XVII



Studies in the structure
of *Microbracon hebetor* Say

Investigations into the Problem of Fly Control in Egypt

(with 2 Text-Figures and Tables I-V)

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I. INTRODUCTION AND ACKNOWLEDGMENTS

The favourable temperature in Egypt, the presence and access of the breeding media of flies such as the different kinds of dung, refuse, etc., and the inadequate sanitary arrangements in the country such as the lack of the water carriage system of sewage and the prevalence of the conservancy methods instead, have greatly contributed to the extreme abundance of flies and have afforded very favourable conditions for fly propagation everywhere especially in the country.

It is easily conceivable that the more is the propagation of flies, the greater is their practical importance since in addition to their being terribly annoying to man and domestic animals their real danger centres in the fact that they are potential vectors of infectious diseases. Typhoid, paratyphoid, dysenteries, summer diarrhoea, conjunctivitis and ophthalmia are very com-

mon diseases in Egypt. The infection with the later disease is so serious that in some of the Egyptian villages, about 90 % of the whole population have suffered from it.

These evidences are sufficiently conclusive to demonstrate that an anti-fly campaign must necessarily form an integral part in any sanitary system especially in this country and that the problem of fly control must receive considerable efforts since it is very essential for the sanitation of the country and the improving of the living and hygienic conditions of the rural population.

Unfortunately, in our country this problem has not received the slightest attention or the least effort. The only account given on fly control in the Egyptian campain is that of Davidson (1918) who carried out some experiments in fly control while camping with military troops in the desert districts of Sinai near Suez. But the methods arrived at — though useful under such special circumstances — yet they cannot be advocated for general use under urban or rural conditions owing to their being impracticable. In other countries the problem of fly control has received intense investigation by some of the important and recent workers, namely Roubaud in France, Thomsen in Denmark, Lorincz and Makara in Hungary, Parisot and Fernier in Lorraine, Sergent in Algiers, Brain in Natal, Schuckmann, Bishopp, etc..

The present paper which is the outcome of about two year's work of extensive field observations and experiments in the country as well as in towns, may throw a light on the question of fly control under conditions prevailing in Egypt, and it is hoped that the results obtained may be of some interest to those working in the fly problem.

The present author wishes to express his profound gratitude to Professor H. C. Efflatoun Bey for his valuable suggestions, incessant support and unfailing encouragement.

To Professor Kamel Mansour I am much indebted for kind help. Special thanks are due to Dr. H. H. Salem for identifying several species of Muscid flies.

II. THE COMMON FLIES, THEIR LOCAL DISTRIBUTION AND RELATIVE PRACTICAL IMPORTANCE

The most common flies which may frequent houses in Egypt and which may be the carriers of the causative organisms of certain of our most prevalent diseases are : *Musca vicina* Macq., *Musca vetustissima* Wlk., *Musca sorbens* Wied., *Musca vitripennis* Meig., *Musca tempestiva* Fallen, *Musca crassirostris* Stein, *Musca nebulo* Fabricius, *Stomoxys calcitrans* L., *Calli-*

phora erythrocephala Meig., *Muscina stabulans* Fallen, and *Lucilia sericata* Meig.

Musca vicina Macq.

Compared with the other species of flies which inhabit or occasionally frequent houses in Egypt, *Musca vicina* Macq., or the Egyptian common house fly, is by far the most abundant. It is the access of the breeding media on one hand and the favourable temperature in Egypt on the other hand which have contributed to the abundance and wide distribution of this species. Generally in the country this fly is more prevalent and abundant than in Cairo and the large towns, that is evidently attributed to the wide distribution of the breeding media such as the dung of the donkeys, sheep and goats in the country and to the almost unhygienic conditions under which the rural population lives. But in some localities in towns and near Cairo where pig breeding is common and pig sties or horse stables are not cleaned or carefully looked after, *Musca vicina* occurs in great abundance.

The house fly as annoying to man and as a vector of infectious diseases is generally recognised. With a view to practical control this fly stands first in importance, since it is responsible for the prevalence of certain of our most common contagious diseases especially in the country. The dissemination of disease mostly takes place by the mechanical transference of the disease germs. The fly constantly frequents and likes the substances used by man for food on one hand and excremental matter, purulent discharges and moist surfaces on the other. Should these different substances contain pathogenic organisms, the proboscis, body and legs of the fly are so densely setaceous that a great opportunity occurs with a considerable probability for the transference of the organisms from the infected material to either stuffs of food or such moist places as the lips, eyes, etc.. In other cases the germs are absorbed by the fly when feeding on infected matter, and again may be deposited by the proboscis since the fly has the habit of regurgitating the food. Infection from the anus may take place by means of infected faecal matter so promiscuously deposited as « fly specks ». The fly is a potent factor in the dissemination of typhoid fever, diarrhoea, ophthalmia, tuberculosis, cholera, etc.. Some of these diseases, such as ophthalmia, are very widely spread in Egypt and the percentage of infected persons especially those of the rural population is very high, and that is directly ascribable to the flies which are the active and important agent in the transmission and spread of the disease.

The other Species of Musca

These are *Musca vetustissima* Wlk., *Musca sorbens* Wied., *Musca vitripennis* Meig., *Musca tempestiva* Fallen, *Musca crassirostris* Stein, and *Musca nebulo* Fabr.. They are generally less abundant than *Musca vicina* Macq., the common house fly, and some of them such as *Musca nebulo* Fabr., *Musca tempestiva* Fallen and *Musca crassirostris* Stein are rather widely distributed in Egypt. These species of *Musca* are almost met with in the country where they breed in cow and buffalo dung which constitutes the great bulk of dung on the Egyptian farms. In the region of Cairo and in the large provincial towns they are of limited distribution and occur in small numbers. Among these species of *Musca* there are *Musca sorbens* Wied. and *Musca vetustissima* Wlk. which may occur near the desert.

As to the dissemination of diseases by these flies it is possible that some of the common diseases in the country such as ophthalmia, infantile diarrhoea, etc., are transmitted by these flies by mechanical transference. In Mesopotamia *Musca sorbens* Wied., according to Patton, is an important transmittor of the organisms which cause the eye diseases. In addition to their danger as vectors of infectious diseases, they are especially annoying to man by hovering around and finding their way into one's eyes, nose, mouth, etc.

Stomoxys calcitrans L.

This blood-sucking fly is common and is widely distributed, occurring especially in the country in the early summer and autumn. In towns it is not commonly met with and sometimes it is very rare. The reason of its common occurrence in the country is the fact that the fly belongs to the byre where it breeds in cattle dung, especially that of calf and cow. When not sucking blood from the cattle, it will be found on the walls and ceilings. Sometimes it occurs in large numbers in horse stables especially when the cattle is out of the byre. In sheep and goat houses this fly is of uncommon occurrence. The fly is naturally an outdoor species, but sometimes frequent houses when it is usually found on the windows, verandas and similar places and inflicts very irritating bites. In the country, near the water canals where the cattle are used to drink, the fly is seen in abundance.

From the practical point of view this species is very important since it is a terrible tormentor of cattle and horses and a possible vector of infectious diseases.

Calliphora erythrocephala Meig.

This fly is an out-door species but it is frequently met with in houses in search of material upon which it deposits its eggs. Generally it is more common in the country than in towns. In the country, owing to inadequate sanitary arrangements, heaps of human excrement are of abundant occurrence and these afford a suitable breeding medium for the fly. Also the carrion and the dead animals in which the fly cheifly breeds are very common in the country. In certain localities in Cairo (observed in Demerdash, 1939), where human excrement is collected in heaps, this fly is of abundant occurrence.

From its habits of frequenting faeces it is not improbable that it occasionally may carry intestinal bacilli on its legs or body or internally, and thus transmit infection. Its flesh-feeding habits may also render it liable to carry the bacilli of anthrax if it comes into access to infected flesh.

Muscina stabulans Fallen

This fly occurs very commonly in houses where it feeds on the house refuse. It is widely distributed in the country where the breeding media such as cattle and horse dung and heaps of human excrement are quite available. Near Cairo, where certain farms exist, the fly is of abundant occurrence in the farmers' houses, especially in the early summer and autumn.

The habits of this species which lead it to frequent dung, human faeces and decomposing animal or vegetable matter, render it a potential disease-carrier. Diarrhoea (Banks, 1912) may be transmitted by this species.

Lucilia sericata Meig.

This species is an out-door fly. It is rarely seen in houses. It is common in the country especially in the farms and farmer's houses where dung and exposed human excrement are very common. The flies usually prefer carrion and dead animals as a breeding and feeding medium. In Cairo and in large provincial towns they are of uncommon occurrence, only in certain localities outside Cairo (observed in Imbaba and Qubba Gardens, 1939) they are frequently seen. This species, owing to its filthy habits, may be a carrier of the causative organism of some diseases.

III. THE BREEDING MEDIA OF THE COMMON FLIES

When tackling the problem of fly control it is obvious that a sound and perfect knowledge of the breeding media and places of the fly is undoubtedly the most important question which the investigator has to solve. Therefore, a long time was devoted to the study of the different breeding media of

Musca vicina Macq., the Egyptian common house fly, as well as the other species of *Musca*, *Stomoxys*, *Calliphora*, *Muscina* and *Lucilia* since they are of common occurrence and their practical importance as possible disease carriers and as annoying to man and. domestic animals is easily recognised. This may help in a better understanding of the fly problem and may throw a light on its practical control. The study and observations have been made in the country as well as in Cairo and several provincial towns. In addition to the field observations, oviposition experiments have been carried out in the laboratory to test the power of attraction of different kinds of breeding media for these different flies.

1. The breeding media of Musca vicina Macq.

Reviewing the literature it seems that Patton (1933) was the only author to refer to the breeding media of this species. He stated that it lays its eggs in large collections of cow dung. Patton's statement differs from the conclusions arrived at by the present author regarding the chief breeding places of this species.

Observations in the country

Some typical cases may be quoted:

April (1939), Sharabas.—A big farm was visited. A large number of cows, buffaloes and calves were kept. Their dung is accumulated in large heaps in a place near the byre, and when these were examined, they were found to contain no larvae of *Musca vicina* Macq.. Also no adult flies were seen to frequent the dung, In another place in the farm a mixture of cow, buffalo and donkey dung was accumulated, and when searched a few larvae were found.

April (1939), Zarka.—A stable that served most exclusively for donkey keeping. About thirty donkeys were kept at night in the stable. As the stable was not cleaned or carefully looked after, the donkey dung was accumulated on the floor and together with the urine of the donkeys and litter, a soft bedding of several inches thick was produced on the floor of the stable. When this bedding was examined it was found to teem with a large number of larvae of *Musca vicina* Macq. The adult fly was also seen in abundance, and numerous batches of eggs were also found.

April (1939), Ibadeih.—A house that served mainly for sheep and goat keeping. About 300 of these were kept at night only, being at pasture by day. The house was not cleaned except at intervals of about three weeks or even more and thus the huge amount of dung was allowed to stay a long time without being removed. Examination of this dung showed the abundant

occurrence of *Musca vicina* larvae. A great number of these occurred near the corners and side walls of the stable. The adult fly was found in prodigious numbers.

May (1939), Shrimsah.— Outside this village there was a large area in which heaps of human excrement were accumulated. The heaps grow gradually through daily addition of fresh excrement. Careful search in these heaps clearly showed that a tremendous number of larvae of *Musca vicina* is found. Most of larvae occurred near the surface layers about two inches deep. Adult flies were found in abundance hovering on the heaps of excrement.

May (1939), Shrimsah.— A farmer's house was visited. About 100 fowls and several ducks were kept in the house. In a corner, a heap of fowl dung mixed with some decomposing vegetable matter was examined and found to contain a large number of the house fly larvae. Several batches of eggs were also seen.

Observations in towns

A few typical cases may be quoted :

May (1939), Mansourah.— In a horse stable owned by some private people about 23 horses were kept, and their droppings being not all removed, some were accumulated on the floor of the stable. Fresh litter however is supplied frequently which absorbs the urine and affords a dry and soft couch to the horses. The result is that the floor of the stable is provided with a thick layer of compact litter mixed with dung and wetted with urine and only the surface being fairly dry. In this thick layer the larvae of *Musca vicina* were found in great abundance especially in the deepest regions where more humidity was available.

May (1939), Abbassia.— A very large horse stable owned by the army was visited. It contained about 120 horses. The stable was cleaned daily and the dung was collected in one of the corners. The cemented floor of the stable was washed several times per day and a poisonous spray (phenol) was frequently used. For this reason flies were rarely seen. The dung accumulated in the corner was examined and was found to contain no larvae, but a few batches of eggs were met with.

May (1939), Cairo.— A large pig sty which served for keeping about 200 pigs was visited. The place was very dirty and accumulations of pig dung of several days old were scattered in all parts of the sty. When the dung was examined it was found to contain very prodigious numbers of *Musca vicina* larvae. Numerous batches of eggs were found on fresh dung. The larvae seemed to prefer the deepest layers of the dung and in several cases were seen on the surface of the soil just below the dung mass where lower temperature and favourable humidity were available.

September (1939), Demerdash-Cairo.—In this district the drainage systems and sanitary arrangements are quite inadequate or even not available. There are no water closets of any kind in the houses. Therefore there is a large area on to which human excrement is accumulated. Careful search showed the presence of numerous larvae of *Musca vicina*. The adult flies were seen on the excrement in large numbers.

Results of observations

A. In the country

(1) Repeated observations have clearly demonstrated that under Egyptian rural conditions the house fly (*Musca vicina* Macq.) will mainly breed in donkey dung mixed with litter in donkey stables. Owing to the wide distribution of donkeys in the country, being the chief beast of burden and means of transport, there are special houses either in the farm or in the village for donkey keeping. Most of these houses are not cleaned or carefully looked after, therefore donkey dung is accumulated on the floor of the stable and as the animals trample about, the dung together with litter, food remains and urine is made into a more or less continuous layer which may be a foot or more in thickness and afford a soft bedding for the donkeys. In this bedding the larvae and eggs are found in greatest abundance. Adult flies are seen in small numbers inside the stables.

(2) Another breeding medium which in my belief plays an important part in the fly production in the country is sheep and goat dung. Sheep and goats are very abundant in the country, and at night they are sheltered in large houses in each of which few hundreds may be found. Large masses of their dung are accumulated on the floor of the house and in these masses which are allowed to stay a long time without being removed the larvae of the house fly are found in abundance. The larvae seem to prefer the regions near the walls and corners of the stable.

(3) It is interesting to know that thorough investigations on farms have shown that cow and buffalo dung which constitute the great bulk of dung on farms do not attract the ovipositing flies except in very rare cases. In large farms cow, buffalo, donkey, calf, sheep and goat dung are all collected together and accumulated in large heaps. These heaps which grow gradually through daily additions may attain a considerable size and finally at the end of several months they are utilised as manure. These heaps especially their upper layers usually teem with a very large number of house fly larvae.

This indicates that cow or buffalo dung when mixed with other sorts of dung such as that of calf or donkey, etc., may be a favourable breeding medium for the common house fly.

(4) Another breeding medium which is not less important than donkey dung is the human excrement. In the greatest majority if not all of the Egyptian villages the water carriage system of sewage is completely lacking, and instead there are the conservancy methods of which cesspits are the more prevalent in the country houses. The cesspit is in the form of a ditch of about two metres deep, and when this is filled with excrement, it is emptied onto large heaps outside the village. In other cases these cesspits are lacking altogether from the houses and then faeces are dropped in pans and emptied when filled and so forth, thus large accumulations of fresh and few days old excrement are found in an extensive area near the village. These accumulations harbour a very great of fly larvae and to a very great extent responsible for the production of the house fly in the country. Adult flies are usually seen in great abundance on the excrement. The temperature generated inside is about 30° C. which is sufficiently favourable for development. Scattered small masses of excrement in roads and subways in the villages, are usually of no importance as breeding media since they dry up too rapidly.

(5) On the other hand fowl dung in some cases plays a part in the propagation of the house fly in the country. Fowl breeding is a prevailing habit among farmers, and a large number of fowls and other birds are kept usually in the farmer's house. The dung of these animals is accumulated and the place being not cleaned or looked after the dung is left long enough to allow the oviposition of the flies. Careful examination of this dung have shown that it contains numerous larvae of *Musca vicina* Macq. In most cases fowl dung is mixed up with decomposing vegetable and animal matter and that mixture affords a favourable breeding medium. Scattered fowl dung does not attract the ovipositing flies, and it dries up very rapidly.

B. In towns

(1) Thorough investigations in several provincial towns and in the region of Cairo have definitely demonstrated that the chief breeding medium of *Musca vicina* Macq. and which is to a great extent responsible for the fly production is horse manure. A great number of the horse stables are owned by private people. The stables are not cleaned except at intervals of weeks or even of months and fresh litter and food remains are supplied frequently which absorbs the urine and affords dry and soft bedding to the horses. The result is that the floor of the stable is covered with a thick layer of compact litter mixed with dung and wet with urine, only the surface being slightly dry. In this bedding larvae of the house fly are found in great abundance especially in the deep layers where more humidity and lower temperature

are available. The temperature of this bedding (30 to 35° C.) is very favourable for the ovipositing females. In the corners of the stable, accumulations of horse dung of few days old which usually harbour a large number of larvae frequently occur.

The stables of the government especially those of the army are also an indirect source of fly production and propagation. A very large number of horses are kept in these stables. The horse dung is usually accumulated in one of the corners. Sanitary measures are taken in these stables by cleaning the floors and using insecticides, and by the daily removal of the dung accumulations from the stables. The dung is loaded in carts and sold to gardeners to be utilized as manure. The real danger remains in these accumulations of horse dung which are taken by the gardeners and left in the open to ferment. Owing to the fact that the dung is loose and not closely packed, fermentation takes place slowly, and in about 10-15 days it is more or less complete. Long before this time is elapsed the life cycle of the common house fly is completed. Under favourable food and temperature conditions which are available in these accumulations of horse dung the life cycle of *Musca vicina* Macq. usually does not exceed six or seven days in the early summer and autumn. Also the temperature of the surface of those dung heaps are favourable enough (about 30 to 35° C.) to attract the ovipositing females. It should be pointed out that these heaps of dung supplied daily by the government stables in which about 400 horses are kept in Cairo only are together of a very large size. Inquiry was made in these stables in Cairo and it has been found that not less than 10 carts (the chamber in which the dung is placed in each cart is about one cubic metre in size) are loaded nearly every day from the different stables of the government. Therefore it is obvious that these very large masses of horse dung left in the open afford a very favourable medium for oviposition and development of the flies.

Single horse droppings scattered on roads are not attractive to the egg laying females. Evidently they dry up too rapidly and are in addition broken up by birds.

(2) As regards pig dung it has been clearly shown from my observations that it is highly favoured as a medium for egg laying. Its power to attract the ovipositing flies is much greater than that of horse manure. It has been also noticed that not only the fresh dung which attracts the egg-laying females, but if the flies are checked in their access to the fresh pig dung they are able to oviposit in older dung, at any rate in dung 4 days old and most likely also in still older dung, as pig dung will retain its original humidity, consistency, specific odour, etc., longer than horse manure, partly at least owing to the fact that fermentation takes place more slowly in this dung than in the horse dung. Lorincz and Makara (1935) have also shown

that the fly breeding capacity of the manure diminishes with the progress of fermentation, but that pig manure retains its capacity for fly breeding much longer than do horse manure. But although the pig dung is the most favourable breeding medium of *Musca vicina*, yet its practical importance and responsibility for fly propagation is very limited owing to the fact that pig breeding is not common in Egypt and the distribution of pigs is restricted to a few localities. In these localities pig sties in which a large number of pigs are kept are found. The sties are mostly not cleaned and the dung is accumulated on the floor, sometimes the dung is collected and placed in the open in a manure pit and this afford a favourable breeding place for the flies.

It may happen in some sties which are carefully looked after that the flies will oviposit partly on the straw of the bedding and partly on small remnants of dung in corners and hidden places which are not cleaned frequently. These observations which reveal the strong attractive power of pig dung as a breeding medium and which clearly demonstrates that—if pigs are widely distributed in Egypt—pig dung will be responsible for fly propagation, are in agreement with those made by Thomsen and Hammer (1936) on Danish farms and Lorincz and Makara (1935) on Hungarian farms.

(3) Another breeding medium of flies which is not less important than the other media is the house refuse. In some cases this refuse including decomposing vegetable and animal matter is collected and accumulated onto large heaps or public dumps placed in the open and these on examination have been found to contain very numerous larvae. But smaller masses of domestic organic refuse are not a favourable breeding medium since they dry up too rapidly and are also broken up by birds and scavengers.

Oviposition experiments

It is now obvious from the observations made in the country as well as in towns that the Egyptian common house fly breeds mainly in definite kinds of manure. In order to acquire a possible confirmation to my direct observation and and to test the power of attraction of different kinds of breeding media to the ovipositing flies, several experiments have been carried out during which the flies were given the option of seven kinds of dung. These were donkey dung, sheep and goat dung, cow dung, human exrement, pig dung, buffalo dung and horse manure. The dung was brought fresh from farms, stables, privy middens, etc., and placed in special wooden frames in the open. Fourteen frames were used two for each kind of dung. The dung was left exposed for oviposition about six hours or more, and then taken and distributed in large vessels (each is about 10 inches in diameter and 6 inches in height) which were covered with muslin. When the adult

house flies emerged they were collected, preserved and identified. This procedure was repeated several times and in each time the flies from each kind of dung were counted.

The results of the individual experiments (see Table I) clearly demonstrate the difference between the power of the individual kinds of manure — expressed in number of hatched individuals — to attract the ovipositing flies. They also show good agreement with the results of direct observation. Therefore it may be safe to definitely consider that horse and donkey dung are the chief breeding media of *Musca vicina* Macq. in Egypt and if pig dung is in access its power of attraction to the ovipositing flies exceeds that of horse and donkey dung.

Human excrement also plays a very considerable part as a breeding medium. Sheep and goat dung comes next to human excrement. Cow and buffalo dung is an unfavourable breeding medium and as rule does not attract the house fly for oviposition.

2. The breeding media of some other species of Musca

It seems from the review of literature that no important account of the breeding places of other species of *Musca* (*vetustissima* Wlk., *sorbens* Wied., *vitripennis* Meig., *tempestiva* Fallen, *crassirostris* Stein, and *nebulo* Fabr.) has been given by previous workers. Patton (1933) gave very short remarks on the breeding media of these species.

Observations in the country

Some typical cases may be mentioned :

April (1939), Dakahla.— A large farm was visited, the dung of cows, buffaloes was intended to be utilized as manure and therefore it was accumulated in heaps which grow gradually through daily additions of fresh dung. One of these heaps of about four days old was examined. It was found to contain a very large number of larvae of *Musca vitripennis* Meig. The larvae were more abundant in the surface and the middle layers of the heap. A second heap placed near the first and which was about eight days old and composed of a mixture of cow, buffalo, calf and little horse dung was examined. It was found to harbour numerous larvae of *Musca tempestiva* Fallen, about 24 larvae of *Musca crassirostris* Stein near the surface and several pupae of *Musca tempestiva* Fallen and *Musca crassirostris* Stein. The pupae mostly occured near the sides and the base of the heap.

April (1939), Kanatir el Khairieh.— A small farm was visited. The dung was not utilized as manure, but as fuel when it dries up. Cow and buffalo dung was collected during the day time and placed near the byre until sun-

TABLE I

Musca vicina Macq. : Oviposition experiments

DATE OF EXPERIMENT	DONKEY DUNG frame 1	DONKEY DUNG frame 2	SHEEP AND GOAT DUNG frame 3	SHEEP AND GOAT DUNG frame 4	COW DUNG frame 5	COW DUNG frame 6	HUMAN EXCREMENT frame 7	HUMAN EXCREMENT frame 8	PIG DUNG frame 9	PIG DUNG frame 10
5.8.1939	238	713	149	614	3	—	210	516	1632	2015
15.8.1939	1210	510	812	640	—	—	744	803	3146	1553
22.8.1939	381	879	210	79	—	—	139	375	826	385
2.9.1939	1370	725	618	823	7	—	813	933	2091	1458
12.9.1939	2003	819	851	713	—	—	1301	805	323	2537

BUFFALO DUNG frame 11	BUFFALO DUNG frame 12	HORSE DUNG frame 13	HORSE DUNG frame 14	Total number of individuals of *Musca vicina*: DONKEY DUNG	SHEEP AND GOAT DUNG	COW DUNG	HUMAN EXCREMENT	PIG DUNG	BUFFALO DUNG	HORSE DUNG
—	—	318	931	951	763	3	726	3647	—	1249
—	1	2130	751	1720	1452	—	1547	4699	1	2881
—	—	461	315	1260	289	—	514	1211	—	776
—	—	1023	911	2095	1441	7	1746	3549	—	1934
—	3	3212	1214	2822	1564	—	2106	2860	5	4426

set when it was taken to the farmer's house. The dung dropped at night was taken on the next day. Sometimes the dung may be left in the farm about two days. The farmer adds some water to the dung which is then made into small flat discs of about two or three centimetres thick and then placed in the sun to dry. Two or three days in summer and five or six days in winter are sufficient for the complete dryness of these discs which are afterwards ready for use as fuel. Careful examination of some freshly made dung discs resulted in the presence of no larvae, only batches of eggs being found. In other cases larvae of *Musca vetustissima* Wlk., *Musca vitripennis* Meig. were seen in the discs but most of them were observed to bore downwards through the substance of the disc and escape towards the surface of the soil on which the discs are left to dry.

Observations in and near towns

These typical cases may be quoted :

May (1939), Qubba Gardens (Cairo).—A modern farm in which a large number of cows, buffaloes, calves and three horses were all kept in different houses. The dung of these animals was collected and placed all in a manure pit.

Every two days the dung accumulated is removed from the pit and loaded in carts and sold for utilizing it as manure or fuel. Just before the removal of the dung from the pit I examined it and found that it teemed with prodigious numbers of larvae of *Musca tempestiva* Fallen, and *Musca vitripennis* Meig. Adults of these species and *Musca nebulo* Fabr. were also seen in abundance. In a near place a mass of pure horse dung of about two days old—probably forgotten by the farmer—was seen and examined. It was found to contain no larvae.

May (1939), Faraskour.—A stable that served most exclusively for sheep and goat keeping. A large number (about 130) of these animals were kept at night. Their dung was not removed except at long intervals and therefore the floor of the stable was provided with a thick layer of dung mixed with straw and litter. When this layer was examined numerous larvae of *Musca vitripennis* Meig. were found. Next to the stable there was a shed in which two donkeys were kept. There was a large mass of their dung which when examined was found to contain no larvae at all. About a hundred metres from the stable a small pig sty containing 15 pigs was visited. The dung of the pig was searched but no larvae were met with, only two adults of *Musca crassirostris* Stein were observed on the dung.

May (1939), Demerdash.—An area onto which accumulation of human excrements were placed was visited. Adult *Musca sorbens* Wied. were seen in abundance on the excrement and the larvae of this species and those of *Musca tempestiva* Fallen abundantly met with inside the faeces.

Results of observations

My observations in the country as well as in the region of Cairo and several provincial towns have clearly shown that the most favourable breeding media of *Musca sorbens* Wied., *vitripennis* Meig., *tempestiva* Fallen, *crassirostris* Stein, *nebulo* Fabr. and *vetustissima* Wlk. are the cow and buffalo dung. Other kinds of dung though less favourable as breeding media, yet in several cases they play a considerable part in the breeding and propagation of flies. On farms the greatest bulk of dung accumulated is that of buffaloes and cows. In large farms the dung is usually utilized as manure, while in small farms it is dried up and then utilized as fuel. In the former case the dung of cows, buffaloes on the farms is accumulated in heaps, in some farms where donkeys or horses are present, then the dung of these animals is also added to the heaps. These heaps may attain a large size and according to observation and investigation they harbour numerous larvae inside and they also attract the flies for oviposition. The temperature on the surface and inside of the heaps is very favourable. Repeated measurements of temperature in such manure heaps have shown that it was 30 to 35° C. in May. In a few cases the dung accumulations take the form of stacks occupying an extensive area. This generally takes place in large and rich farms which keep an enormous number of cows, buffaloes, donkeys and horses, etc.. The dung of these animals is stacked, the stack may reach five metres high and the surface area about two hundred square metres. The surface layer of the stack which is kept moist by fresh daily additions of dung attracts the ovipositing flies in large numbers and the temperature is also sufficiently favourable for the completion of development.

In the small farms the dung is made use of as fuel and therefore it is not allowed to stay a long time as in the case of large farms. The boys in the farms collect the droppings of the cows and buffaloes and pile them in a place near the byre. In about two or three days the quantity of the accumulated dung attains a moderate size, then it is mixed up with some water and made into circular flat discs, each of about two or three centimeters thick, and these left to dry in the sun. In about two or three days in summer and five or six in winter the dung disc dries completely and becomes ready for use as fuel. The dung before this process usually contains numerous larvae and batches of eggs. These may be also found in the discs and until the discs become completely dry some of the third stage larvae present may succeed to develop and pupate. That was demonstrated by the presence of pupae just below the discs on the soil. In other cases the dung dropped by the animals during the day time is collected and left till the next morning when the dung dropped at night is added to it, thus the dung on these farms is allowed to stay a short time for the oviposition of flies. But in this case

it is obvious that the eggs or first stage larvae that may be present in dung fail to complete development owing to the fact that the discs dry in a short time especially in summer.

As regards the dung accumulated in the cow and buffalo stables it is to my mind of more importance from the practical point of view than that accumulated on farms, and is responsible for the production of large numbers of flies in the country. The conditions in these cow stables are rendered more favourable for development by the presence of suitable temperature and humidity. These stables are not cleaned except at long intervals, and not all the dung is removed but a part of it is left on the floor of the house to afford when mixed with straw and food remains a soft bedding for the buffaloes and cows. The bedding is very attractive for the egg-laying females. The removed dung is usually accumulated on the roof of the house, and then made into discs which will be left in the sun to dry. Larvae which may be present in this dung may or may not succeed to complete development.

Thorough investigations have clearly demonstrated that horse manure may be a favourable breeding medium for some species only, namely *Musca sorbens* Wied. and *Musca tempestiva* Fallen. The manure is rendered more attractive for ovipositing flies when mixed with cow, buffalo or calf dung. That frequently takes place in the region of Cairo and provincial towns where several horse stables are of common occurrence.

Sheep and goat dung has been found to play an important part in the propagation of these flies. This dung is quite available in large quantities owing to the wide distribution of sheep and goats in the country where several houses are fitted most exclusively for their keeping. Such houses or stables are not carefully looked after and the dung of the animals is intentionally left on the floor to serve as a bedding for goats. This bedding usually contains an enormous number of larvae the development of which may be accelerated by the favourable temperature (30 to 38° C.) and humidity available in the stables.

As regards human excrement it has been found to be attractive to the ovipositing females of most species of *Musca* especially *Musca sorbens* Wied. and *Musca tempestiva* Fallen which seem to highly favour this substance as a breeding medium for their larvae have been found several times in large numbers inside the excrement. The part played by human faeces in the breeding and propagation of flies is more considerable in the country as well as in a few districts in towns where huge accumulations of excrement occur in the open owing to inadequate sanitary arrangements and drainage systems.

The other kinds of dung, namely pig, donkey and fowl dung, have been found to be of no importance as breeding media. The adult flies may be attracted to the dung probably for feeding and not for laying eggs. Also the

TABLE II

Oviposition experiment : 5.VIII.1939, Abbassia

SPECIES	DONKEY DUNG		SHEEP AND GOAT DUNG		COW DUNG		HUMAN EXCREMENT		PIG DUNG
	frame 1	frame 2	frame 3	frame 4	frame 5	frame 6	frame 7	frame 8	frame 9
Musca sorbens	5	—	105	96	672	231	86	101	—
Musca vitripennis	—	13	232	135	379	850	30	260	—
Musca tempestiva	—	—	—	—	231	536	38	130	1
Musca crassirostris	4	—	23	7	52	91	—	16	—
Musca nebulo	—	—	—	—	333	185	—	120	—
Musca vetustirsima	—	—	12	—	41	138	—	16	—

SPECIES	BUFFALO DUNG		HORSE DUNG		Total number of individuals emerged						
	frame 11	frame 12	frame 13	frame 14	DONKEY DUNG	SHEEP AND GOAT DUNG	COW DUNG	HUMAN EXCREMENT	PIG DUNG	BUFFALO DUNG	HORSE DUNG
Musca sorbens	988	698	230	40	5	201	903	187	—	1686	270
Musca vitripennis	1381	713	142	99	13	367	1229	290	—	2094	241
Musca tempestiva	333	181	78	136	—	—	767	168	1	514	214
Musca crassirostris	21	39	31	—	4	30	143	16	—	60	31
Musca nebulo	653	781	—	—	—	12	518	120	—	1434	—
Musca vetustirsima	138	230	—	—	—	—	179	16	—	368	—

flies show a strong repugnance of egg laying in kitchen refuse. Repeated search for larvae or eggs in this substance mostly resulted in the presence of none.

Oviposition experiments

These experiments have been carried out in conjuction with those of *Musca vicina* Macq. The result of one of the typical experiments is given in Table II. It clearly shows that the power of attraction of cow and buffalo dung for the ovipositing flies of *Musca sorbens* Wied., *vitripennis* Meig., *tempestiva* Fallen, *crassirostris* Stein, *nebulo* Fabr. and *vetustissima* Wlk. is by far much greater than that of other kinds of dung. Horse manure, sheep, goat dung and human excrement seem according to the numbers of hatched individuals that they attract the egg-laying females nearly in the same proportional degree. Other breeding substances such as pig dung and donkey manure are generally not attractive to the ovipositing flies.

3. The breeding media of Stomoxys calcitrans L.

The review of literature reveals that no studies on the biology of *Stomoxys calcitrans* L. have been made in Egypt. In Europe, no important account on the biology of the fly with a view to practical control has been given except that of Thomsen and Hammer (1936).

Newstead (1906) in his study of the life history of *Stomoxys* did not find larvae or pupae of *Stomoxys* in cattle dung in fields or heaps of manure.

Portschinsky (1910) states that *Stomoxys* breeds chiefly in horse manure around stables, and not in cattle dung in similar places. He observed that no oviposition takes place in horse or cattle dung in open fields.

Mitzmain (1913) in his account of the bionomics of *Stomoxys* stated that he had observed egg-laying in horse dung.

Hindle (1914) stated that stable manure and decomposing vegetable matter constitute the chief breeding media of *Stomoxys*.

Wilhelmi (1917) observed that *Stomoxys* did oviposit in cattle dung. He is more inclined to believe that oviposition occurs mainly in the byre, and the eggs or young larvae as they are transferred with the dung to the manure heap, may continue and complete development.

Bishopp (1920 and 1931) in his very important account of the stable fly stated : « Horse manure has been considered the normal breeding medium for this pest. Investigations made during the outbreak in 1912 showed clearly, however, that the vast majority of the flies bred out in straw stacks, and investigations made around stables and barns indicate that while the fly breeds in pure horse manure, it favours a mixture of this substance with straw... ». Further down he states : « The manure piles commonly found

near stables where horses are kept furnish suitable breeding conditions. This is especially true in the early spring, when the warmth of the manure appears to be very attractive to the flies for egg-laying ». He also stated : « Experimentally, a few specimens have been reared from pure cow manure, but this substance seems to be unattractive to the adult and not favourable for the breeding of the larvae on account of its very compact texture. The stable fly has never been found breeding in human excrement and does not frequent malodorous places... ».

Surcouf (1921) observed the egg-laying of *Stomoxys* in horse manure. He stated that if fresh horse dung is not present, *Stomoxys* oviposits along the manure heaps in the soil fouled with debris and urine.

Patton (1931) mentioned in page 224 that the female « lays the eggs singly in horse manure, straw soiled with urine, stable bedding, decaying vegetation and household refuse especially tea leaves ».

Seguy (1933) has observed the oviposition of *Stomoxys* in fresh horse, cow and rabbit dung in stables and byres. In rare occasions oviposition takes place out doors on heaps of manure.

Thomsen and Hammer (1936), in their account of the breeding media of some common flies, made extensive observations on Danish farms, and carried out several oviposition experiments in the laboratory to find out the chief breeding media of *Stomoxys*. They stated : « *Stomoxys calcitrans* L. breeds chiefly in the bedding of calf boxes (litter mixed with dung and urine), to a much smaller extent in humid remains of straw, old fodder or other vegetable material left in corners and crevices of stables. *Stomoxys* larvae were only rarely found in horse manure, pig dung and cow dung, Oviposition in the open has not been observed and if existing is quantitatively of no importance ». They also observed from the oviposition experiments that *Stomoxys* preferred egg-laying in horse manure and calf dung.

Observations in the country

The following typical cases may be quoted :

April (1938), Zarka.—A large farm was visited at the beginning of the month. Numerous cows, buffaloes, calves, donkeys and few horses were kept. There was a considerable number of stable flies in the byre (out of a number of 80 individuals examined there were 74 *Stomoxys*). In the horse and donkey stables neither the flies nor their larvae were met with. In a manure heap (mixture of cow, horse and donkey dung) placed near the horse stable about six larvae of *Stomoxys* were found. In the floor of the calf pen there was a thick layer of compact litter and manure which contained a rather large number of *Stomoxys* larvae and pupae. They were found especially along the side walls.

May (1938), Kanatir El Khairieh.—A stable in which a large number of sheep and goats were kept. In a part of the stable three calves and two horses were found in separate enclosures. A few stable flies were met with in the place where sheep and goats were kept, and when their dung was examined it was found to contain no *Stomoxys* larvae. In the calf and horse enclosures there was no adult flies but the larvae were found in small numbers in horse dung and in moderate abundance in calf dung.

Observations in the region of Cairo and some towns

June (1938), Mansourah.—A large stable owned by private people and fitted most exclusively for horse keeping was visited. About 22 horses were found. Their dung is not removed daily and therefore large accumulations of pure horse manure occurred on the floor of the stable. While *Stomoxys* was seen in the stable especially on the walls and ceiling in great abundance, the *Stomoxys* larvae were found in small numbers. But in a near place to the stable a heap of horse dung mixed with straw and urine was found. When this was examined it was found to contain an enormous number of *Stomoxys* larvae.

June (1938), Wailieh.—A more or less primitive farm in a part of which the owner and his family dwells. They lived in two small rooms and were terribly annoyed by the stable fly. Four calves and three cows were kept in a shed close to the farmer's house. Most of the flies examined in the calf pen were found to be *Stomoxys* which seem to migrate to the farmer's house when calves are out at pasture. Near to the barn a heap of humid straw mixed with urine of cattle and some decomposing vegetable matter was examined, and was found to teem with a large number of *Stomoxys* larvae. About a few scores of yards from this farm there was a pig sty containing about 100 pigs. The place was very dirty and the pig dung was found in in large quantities on the floor of the sty. The adult fly was rarely found, but a few larvae were observed in the dung.

September (1938), Demerdash.—A large heap of human excrement left in the open outside the houses was examined. The adult fly was never found on the excrement, and also the larvae were completely absent from it.

Results of observations

Careful investigations in the country have clearly shown that under Egyptian rural conditions the stable fly *Stomoxys calcitrans* L. breeds chiefly in the byres as well as in the calf pens. In these places cows, buffaloes and calves are kept. Some of the dung of these animals is intentionally left by

the farmer on the floors of the byres and pens to afford a soft bedding for the cattle, and usually this bedding is mixed up with straw and food remains and weted with urine. This mixture of dung, straw, urine, etc., was found to be a very favourable breeding medium for *Stomoxys* and the more is the amount of straw and urine the greater is the number of the larvae found. The eggs are deposited singly and usually close to each other, and are forced slightly into the surface of the dung in order to be protected against desiccation. The temperature in these breeding media may be favourable enough to accelerate the period of development. It genrally ranges between 25° C. and 30° C., and sometimes more especially when the quantity of humid straw and litter is greater. In pure cow, buffalo or calf dung the stable flies are usually not attracted for oviposition, and only in a very few cases the larvae were found in pure cow and calf dung in a very small number. Therefore it seems that mixing with humid straw or litter, etc., is a very essential condition for rendering cow, buffalo or calf dung attractive for the egg-laying females of *Stomoxys*. In byres which are carefully looked after and cleaned regularly, oviposition is evidently scanty, but the adult flies may be found in abundance especially when the cows are present and not out at pasture.

The stable fly breeds also extensively in straw stacks, humid remains of litter soiled with urine, etc., and it is unnecessary for these remains to be mixed with dung, but humidity is an indispensable condition for egg-laying and development. Under conditions prevailing in Egypt, especially in towns, there is a rich and constant source of this humid straw which is soaked with urine and slightly mixed with dung. In all the government horse stables a layer of moderate thickness of straw is placed on the cemented floor of the stable where the horses stand. This layer affords a soft bedding for the horses at night, and is naturally wet with urine. Every one or two days this bedding is removed from the stable in carts and left exposed in the open to be utilized as manure. This has been found to be attractive to egg-laying females and considerable numbers of *Stomoxys* larvae are usually met with. The importance of these bedding in the fly breeding can be very easily realised if we know that this breeding substance (humid straw with urine) is furnished daily in very large quantities by the government stables especially those of the army.

In donkey stables the donkey dung mixed with straw and wet urine also affords a favourable breeding medium for *Stomoxys*.

As regards sheep and goat dung it has been found that it is of very little importance as a breeding medium for *Stomoxys*. Only when it is mixed with some decomposing matter or remains of straw it may be slightly attractive for ovipositing flies.

Also repeated investigations have definitely shown that the stable fly

as a rule never breeds in human excrement and usually does not frequent the cesspits, latrines, privy middens or similar places.

In the region of Cairo and several provincial towns it has been found that horse manure mixed with straw and wetted with urine affords suitable breeding medium for *Stomoxys*. The favourable temperature of the dung (about 35 to 38° C.) may contribute to the attraction of the egg-laying females and the acceleration of the developmental period. These conditions are usually furnished in the thick layer of dung and litter which occurs on the floor of horse stables. In large and tightly packed heaps of this manure larvae or eggs are usually not found, that is evidently due to the fact that strong fermentation may take place and the temperature may be sufficiently high to prevent oviposition and development.

But it should be pointed that the part played by this kind of manure in the propagation of *Stomoxys* is decidedly inferior to that played by cow, buffalo and calf dung mixed with straw. In pure horse dung, it seems that oviposition is not common.

As regards pig dung it has been shown that it is not a suitable breeding medium for *Stomoxys* and not attractive for the ovipositing females. The adult flies may be found in the pig sty mainly for biting the pigs. The larvae are rarely found in the dung.

Observations have also shown that *Stomoxys* under the conditions prevailing in this country oviposits in the open as well as in doors in the stables, but more extensively in the latter case.

Oviposition experiments

The above mentioned observations clearly demonstrated that under conditions prevailing in this country the stable fly prefers certain kinds of manure for oviposition. Therefore, as in the case of *Musca vicina* Macq. and the other species of *Musca*, oviposition experiments have been similarly carried out in case of *Stomoxys* in order to test this degree of preference or in other words the power of attraction of the different kinds of breeding media for the ovipositing females.

The experiments have been made in the early summer (April and May, 1938) in the open as well as in doors in the byre and pig sty at Wailieh near Cairo. For each experiment pottery vessels each of about 20 cms. in depth and about 30 cms. in diameter were used. Seven of these vessels were placed in the byre and seven in the open. Seven kinds of dung namely cow dung, buffalo dung, calf dung, horse dung, donkey dung, pig dung and sheep and goat dung were used, and each vessel contained a kind of dung. The dung applied was as far as possible taken fresh from the animals, but it was not sterilized by heating to avoid any possible change in its properties. This

TABLE III

Stomoxys calcitrans L. : Oviposition experiments

DATE OF EXPERIMENT	Vessels exposed in the byre and pig sty							Vessels exposed in the open		
	DONKEY DUNG	SHEEP AND GOAT DUNG	COW DUNG	CALF DUNG	PIG DUNG	BUFFALO DUNG	HORSE DUNG	DONKEY DUNG	SHEEP AND GOAT DUNG	COW DUNG
	Vessel 1	Vessel 2	Vessel 3	Vessel 4	Vessel 5	Vessel 6	Vessel 7	Vessel 8	Vessel 9	Vessel 10
3.4.1938	3	—	31	77	2	15	271	36	6	7
15.4.1938	—	8	15	88	12	35	116	12	—	46
28.4.1938	127	1	32	36	18	—	59	—	11	10
12.5.1938	—	7	26	—	1	18	94	17	—	33
30.5.1938	18	—	6	19	—	1	70	—	5	—

DATE OF EXPERIMENT	Vessels exposed in the open				Total number of individuals						
	CALF DUNG	PIG DUNG	BUFFALO DUNG	HORSE DUNG	DONKEY DUNG	SHEEP AND GOAT DUNG	COW DUNG	CALF DUNG	PIG DUNG	BUFFALO DUNG	HORSE DUNG
	Vessel 11	Vessel 12	Vessel 13	Vessel 14							
3.4.1938	13	21	2	186	39	6	38	90	23	17	457
15.4.1938	92	—	15	98	12	8	61	180	12	50	:14
28.4.1938	10	7	52	31	127	12	42	46	25	52	90
12.5.1938	3	—	21	115	17	7	59	3	1	39	209
30.5.1938	44	2	13	68	18	5	6	63	2	14	138

procedure does not guarantee with certainty that the dung utilized might not have contained any eggs at the beginning of the experiment, but there is however no reason to believe that this condition had any considerable influence on the final result of the experiment.

After the vessels had been exposed for egg-laying for about six or sometimes eight hours they were taken to the laboratory where they were covered with special wire netting. When the flies hatched a net was applied to the vessel and the adult flies were obtained, preserved and counted. Generally the results of the individual experiments show agreement with those obtained from direct observation. The experiments have shown that the diferent kinds of dung attract the ovipositing females of *Stomoxys* in varying degrees (see Table III).

Pure horse manure according to experiments had the greatest production of *Stomoxys* as compared with other kinds of dung. Pure cow, buffalo and calf dung attract the ovipositing females to a slight degree. Pig and sheep and goat dung are also little attractive for *Stomoxys*. Donkey dung in one of the experiments yielded a considerable number of *Stomoxys*.

It should be also pointed out that it was noticed from the experiments that the difference in number between the adult emerged from the vessels exposed for egg-laying in door in the byre and those emerged from the vessels exposed in the open is not a considerable one, indicating that oviposition in the open and in the byre may take place nearly in the same proportional degree.

4. The breeding media of Calliphora erythrocephala Meig., Lucilia sericata Meig., and Muscina stabulans Fallen

The review of literature show that the breeding media of these flies have been taken into consideration by some previous workers in different countries. Howard (1900) has recorded *Calliphora erythrocephala* Meig. and *Muscina stabulans* Fallen from human excrement. The latter species was also reared from cow dung. Hewitt (1914) stated that *Calliphora* breeds in faeces and decaying flesh, and *Muscina* in various kinds of decaying fruits, etc.. Portchinsky (1913) has pointed out that *Muscina stabulans* Fallen not only breeds in human excrement and cattle and horse dung but also in meat, carcases of different vertebrates and invertebrates, vegetables, dung, etc.. Patton and Evans (1929) have mentioned that while *Calliphora erythrocephala* Meig. and *Lucilia sericata* Meig. breed in the dead bodies of animals of all kinds, *Muscina stabulans* Fallen breeds in addition, in decaying vegetable matter.

In Egypt, the study of the breeding places of these flies have not been

previously attempted although they are of abundant occurrence especially in the country, and may be important from the practical point of view. Several observations have been made in different localities in the country and in towns in abbatoirs, slaughter houses and wholesale meat merchants, etc.. The results arrived at definitely prove that these flies show a marked preference in ovipositing in carrion, dead bodies of animals, rotten flesh of any kind, etc., and also emphasize the importance of human excrement which seems to be responsible to a great extent for the production and propagation of these flies in Egypt. As it is previously pointed out, human excrement, owing to inadequate sanitary arrangements and the prevalence of the conservancy methods of sewage in the country as well as in some localities of certain towns, occurs in huge accumulations exposed in the open and these afford a very favourable breeding media for these flies especially *Calliphora erythrocephala* Meig. and *Muscina stabulans* Fallen which extensively breed in this substance. Observations have also shown that oviposition is preferred on excrement a few hours after deposition. The temperature inside these accumulations usually ranges between 25 to 35° C. in April and September, which is almost sufficiently favourable to allow oviposition and accelerate the period of development. The other excremental matter such as cattle dung, horse and donkey manure, etc., are generally unfavourable breeding media for these flies except *Muscina stabulans* Fallen which favourably breeds in cow and horse dung. *Lucilia sericata* Meig. and *Calliphora erythrocephala* Meig. rarely oviposits in cattle dung. As regards the decaying animal matter such as the carcases of different animals, etc., it may be said with certainty that these are highly favoured by the flies as breeding media, and that oviposition occurs in these carcases very extensively. Especially in the country the dead bodies of donkeys may be frequently met with outside the villages. These corpses, owing to their large size, usually remain quite a long time before they are completely consumed, and that obviously renders oviposition more extensive and larval development and food conditions more favourable. Carcases of smaller animals such as cats, fowls, rabbits, etc., are undoubtedly less important breeding media since they usually dry up before development is completed. House refuse with decomposing vegetable matter may serve as a breeding substance for *Muscina stabulans* Fallen but, as rule, it plays a very minor role in the propagation of this fly. That is probably attributed to the high temperature in Egypt which contributes to the rapid desiccation of such substances and thus rendering them unfavourable breeding media.

Summary

(1) Under conditions prevailing in Egypt, the horse dung deposited in stables owned by private people as well as that removed from the government stables and exposed in the open afford the chief breeding medium of *Musca vicina* Macq. in towns, whereas in the country donkey dung deposited in stables is the one concerned. Human excrement, owing to inadequate sanitary arrangements and the presence of conservancy methods of sewage disposal in the country, plays a very important part in the production of flies. Sheep and goat dung comes next to human excrement in its practical importance in the fly propagation. Pig dung is of minor importance owing to the limited distribution of this animal in Egypt. It is very striking that *Musca vicina* Macq. never breeds in cow, buffalo or calf dung.

(2) Other species of *Musca*, namely *sorbens* Wied., *vitripennis* Meig., *tempestiva* Fallen, *crassirostris* Stein, *nebulo* Fabr. and *vetustissima* Wlk., mainly breed in cow and buffalo dung deposited in byres under rural conditions in Egypt. Horse manure is a much less favourable breeding medium, but when mixed with cow, buffalo or calf dung it becomes more attractive for ovipositing females of *Musca sorbens* Wied. and *Musca tempestiva* Fallen. Sheep and goat dung and human excrement are also important as breeding media for these flies, but it seems that *Musca sorbens* Wied. and *Musca tempestiva* Fallen highly favour human excrement as a breeding medium. Other kinds of breeding substances such as pig dung, donkey manure, house refuse, etc., do not attract the ovipositing flies.

(3) *Stomoxys calcitrans* L. in the country chiefly breeds in cow, buffalo and calf bedding (humid straw mixed with urine and dung) in byres and calf pens, while near towns it breeds in horse bedding (humid straw mixed with urine) removed from the stables and exposed in the open. Pure cow, buffalo, calf and horse dung is little attractive for the ovipositing females. Donkey dung deposited in stables and mixed with litter may be a favourable breeding medium in the country. Sheep and goat dung, human and pig excrement are as a rule of no importance as breeding media for *Stomoxys*.

(4) *Calliphora erythrocephala* Meig., *Lucilia sericata* Meig. and *muscina stabulans* Fallen are mainly attracted by carrion, dead bodies of animals and rotten flesh of any kind for oviposition and breeding. But these substances do not — as a rule — constitute the principal source of production of these flies owing to their uncommon occurrence. Human excrement, though less attractive yet as a whole, has the greatest production of these flies especially in the country where there is a lack of sanitary arrangements and water carriage systems of sewage, the excrement being left exposed in the open. Other breeding substances, such as house refuse and decaying vegetable matter, may attract *Muscina stabulans* Fallen for oviposition, but generally their importance as breeding media is very little.

IV. MEASURES OF FLY CONTROL

The results arrived at from experiments and observations made with the aim of studying the breeding media of flies have clearly demonstrated and definitely proved that the different flies chiefly breed in definite kinds of dung and other breeding substances which are mainly responsible for the fly propagation. That is very essential in tackling the fly problem since it facilitates its practical control.

The measures of control should concentrate against the early stages of the flies (eggs, larvae and pupae) and not only against the adult. The use of fly straps, insecticides and fumigatiin methods, etc., in byres, stables and living rooms is none the less extremely useful as a measure of secondary importance. The methods of fly control which I have studied will be mainly directed to :

A. The stable refuse.

B. Dung deposited on farms.

C. Accumulations of human excrement exposed in the open.

A. The stable refuse

It is now obvious from studying the breeding places of the house flies that stables constitute one of the principal sources of fly production under conditions prevailing in Egypt. The horse stables will be first taken into consideration, the others, including cattle sheds, calf pens, donkey stables, etc., will be discussed later.

A large number of horse stables is owned by private people. The stables are not cleaned except at long intervals of weeks or even of months and thus accumulations of horse dung occur on the floor of the stable. Some of this dung take part in the formation of the bedding of the horses, the other which is the major quantity is left exposed in the open for several days to ferment. The surface temperature which is about 35°C. in the early summer in such exposed heaps is usually sufficiently favourable to attract the ovipositing females. That was evidently proved by observing a large number of batches of eggs on the surface. In the centre of the heap the fermentation temperature may be high enough to kill the larvae, but these usually migrate to the surface and lateral regions where lower temperature is available. These heaps of horse dung are indeed, under conditions prevailing in this country, a considerable source of fly propagation. The developmental period of flies is accelerated by the favourable food and temperature conditions. After testing several methods for their efficiency in the prevention of fly breeding in horse manure, my observations and experiments definitely prove that the biothermic method together with some supplementary measures are the most useful in this respect and give the best results.

Thomsen (1934) has pointed out that covering the horse or pig manure with cow dung seems to be an efficient method of reducing the number of flies on Danish farms. This is based on the fact that in Denmark — and probably in some other countries—cow dung generally does not attract the house flies for oviposition. But since cow dung in Egypt affords the most suitable breeding medium for several species of *Musca*, it will be obvious that such method advocated by Thomsen cannot be applicable here, and even if this drawback is surmountable I am inclined to believe, supported by observations, that the efficacy of Thomsen's covering method with cow dung is doubtful since cow dung when mixed with horse or pig dung becomes attractive to the egg-laying females, and in addition if the manure underneath consists of fermenting horse dung, the steam given off may be sufficiently strong to permeate through the covering of cow dung on the surface and thus house flies are attracted for oviposition on cow dung. That was proved by observations on some farms, and is in agreement with Roubaud (1936). Also covering the manure heaps with sacks, tarpaulins, as suggested by Thomsen (1934), would be perfectly successful if the steam given off during fermentation is not of a high temperature which may cause the rapid deterioration of the cover, and consequently flies may lay large quantities of eggs on the parts of the cover which have become worn or thin and therefore it is uncertain whether this method can be advocated for general use under rural conditions (Roubaud, 1936).

The spreading of manure in a thin layer of about 5 cms. in thickness has been tested and tried several times as a measure of preventing the fly breeding and in all cases very satisfactory results have been obtained. In spring, summer and autumn such layer of manure spread on the ground in the sun requires two days or less to become completely dry owing to the high temperature—which may reach 50° C. or more—in Egypt in these seasons. In winter the time may be prolonged to about four days or more, but in either cases any eggs or larvae that may be present in this layer of dung will in all probabilities fail to complete development and will perish through lack of food and unfavourable conditions of humidity. This method was tested by Lorincz and Makara (1935) in Hungary. The method has some disadvantages, it requires a considerable amount of labour and a prolonged supervision in order to obtain good results. Moreover an extensive area is necessary for the spreading of the manure especially when the latter is in enormous quantities. Some of the larvae may also bore downwards and reach the surface of the soil beneath and may succeed to pupate. That was proved to be the case in several occasions especially on the advent of winter, when pupae were collected in considerable numbers about three inches deep in the soil just below the dung. The wind may also carry particles of the

dung anywhere. Furthermore, when this method was suggested to farmers, gardeners, etc., it was instantly rejected as laborious and needing a considerable effort.

The use of chemical insecticides as a principal method for combating the fly breeding in horse dung was also tried. Spraying manure heaps with fly deterrent solutions has often been favoured, apparently owing to the fact that the flies are not attracted to manure after being sprayed, and that any larvae present will be killed. But in order to prove that this is not always the case, especially in large manure heaps, a simple turning over of the surface of the manure clearly shows that the fly larvae can be found beneath, the solution sprayed on the surface having failed to check the hatching and subsequent development of larvae from the eggs previously laid on the fresh manure. It has been also found that treating the manure with insecticides generally inhibits or retards the process of fermentation. Solutions of kerosene, phenol have been tested and proved useful with small heaps of manure, but in large heaps they serve as a supplementary measure only owing to the fact that they evaporate rapidly, especially in hot weather, and their effect becomes very evanescent and flies have been observed to lay eggs on manure shortly after spraying. Also numerous larvae have been found to escape the destructive action of these insecticides. The resistence of larvae to the action of chemicals is very pronounced but there are certain larvicides which give very satisfactory results such as borax or hellebore. But it should be pointed out that although the application of chemicals to manure heaps may give good results in the hands of capable and conscientious people yet it cannot be advocated in a general way as a principal measure of control, and moreover it is practicable only in cases where expense is of no consideration.

As recommended by Madsen Mygdall the hot water of about 70 to 90° C. was used for killing the fly larvae in horse manure, but it has been found after several trials that this method does not always give good results especially where the daily quantity of manure is comparatively large, but as a supplementary measure it is undoubtedly useful.

After testing the efficacy of all the methods mentioned above in the prevention of fly breeding in horse manure, the present author has come to the conclusion that the most efficient method is the biothermic method applied together with one or more of the supplementary measures.

The underlying principle of this method is the destruction of the house fly in its early stages, mainly the larval stage, by means of a process involving the tight and close packing combined with frequent turning over the upper layers and subsequent storage for fermentation, entirely carried out in a suitable receptacle so constructed as to form a larval trap.

The pressing down of the manure which is frequently watered results

into the generation of a high temperature owing to the process of fermentation. The temperature, especially in the centre of the fermenting manure, may be as high as 90° C. which is of a very detrimental effect and absolutely fatal to flies at all stages of development. It was found, however, that numerous larvae escape from the hot middle regions and migrate to the surface and lateral regions of the heap where temperature is lower, and thus many of them may succeed to complete development and pupate. Therefore, precautions were taken and their migration was prevented by the presence of an open channel in which they are entrapped and killed in borax solution. Moreover, the escape of the larvae over the walls is checked by the projecting and overhanging ledge which cause them to fall back on the heap. In order to prevent the larvae from reaching the soil beneath the packed heap, the

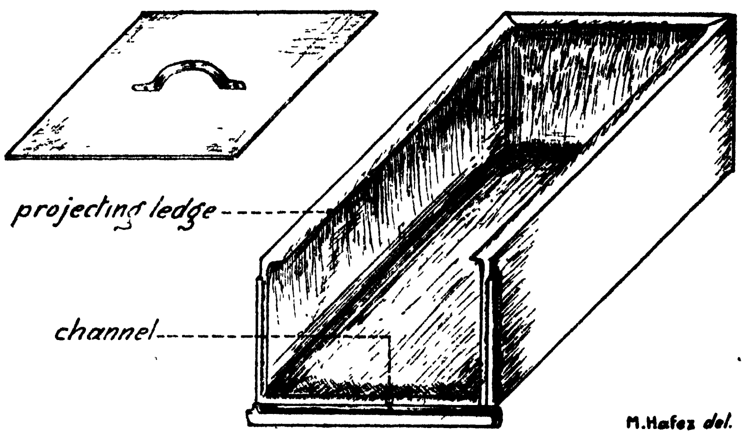


Fig. 1. — Storage chamber.

floor of the receptacle must be completely impervious. The outer exposed layers of the manure heap must be raked off and turned into the hot centre every day during the process of close packing in order to kill any larvae that have migrated to the surface. When the rammed manure heap attains a convenient size, it is left to ferment and frequently watered to promote the process of fermentation for killing the surviving larvae and rendering the manure unattractive for ovipositing flies.

Based on these facts and bearing in mind the necessary precautions, two manure receptacles or chambers have been constructed for alternative use. They proved very satisfactory and excellent results have been obtained. With minor modifications they may be adaptable to any local conditions, for they are not expensive and again the method can be very easily carried out at rural or urban conditions. The chamber (Fig. 1) is a wooden box

(1.50 × 1.00 × 0.50 metres) lined internally with zinc. The box is three-sided — the roof being removed and there is an open gutter in front. To this open front a sliding wooden shutter is fitted in a special groove, and it serves only to protect the open gutter from falling manure and is not intended to help close packing by any means since it is not suited for this purpose either structurally or from its position. When the shutter is fitted, care must be taken in order to prevent it from closing completely down. This provision allows the migrating larvae to pass beneath the shutter to be trapped in an open channel beyond. The floor of the chamber leads in front into an open channel made of zinc running close to the front edge and slightly sloping and closed from either sides by means of stoppers. The channel is filled with a solution of borax prepared by dissolving one sixth of a pound in a gallon of water. The upper edges of the lining zinc are made in such a way that they project inwards and provide an overhanging sharp edge.

TABLE IV

Temperature generated
in fermenting horse manure heap

DATE	TEMPERATURE IN °C. AT 11 A.M.	TEMPERATURE IN °C. AT 3 P.M.
3.9.1939	68	66
4.9.1939	72	75
5.9.1939	83	79
6.9.1939	80	81
7.9.1939	82	82

Into one of the two chambers the horse dung from the stable is stocked daily and then pressed down tightly. Every day's dung is accumulated on the previous day's supply and rammed closely against the floor and the side walls. The liquid manure is drained off from the open channel in which the borax solution is placed immediately after. The base of the stacked manure in the chamber must be away from the open channel in front by at least ten inches. After few days, the stacked manure heap becomes sufficiently large to fill the chamber, but it should be borne in mind that the surface of the heap must be away from the inwardly projecting edges of about six inches. The chamber being now filled, the shutter is fitted and then left for a few days in order that the manure contained completes the process of fermentation. Every morning the turning over of the surface layers and the addition of some water are necessary. During this time, the other chamber may be

used, and when filled the first chamber is emptied and used and so on alternatively. During the process of fermentation a high temperature is engendered. Measurements of temperatures were taken twice or more every day by placing the thermometer in the centre of the fermenting manure heap. The temperature recorded (see Table IV) is sufficiently high to destroy all the early stages of flies. In several cases the temperature may reach a maximum far in excess of the temperature necessary to kill the larvae. The highest temperature recorded was 92° C. In order to investigate the larvicidal action of temperature generated in the manure heap a series of experiments have been conducted. The conclusion arrived at clearly demonstrates that the stage of development of the larvae in an important factor in determining the lethal degree of temperature and the time of exposure required (see Table V). First stage larvae of *Musca vicina* Macq. are generally killed in about 10 seconds at a temperature of 55° C., the second stage larvae in about 22 seconds, the third stage larvae in about 35 and the fully mature larvae in about 100 seconds at the same degree of temperature. These measurements have been obtained in « wet » heat i.e., the larvae were submerged in water.

TABLE V

Period of exposure *in seconds* which proved to be fatal to larvae of *Musca vicina* Macq.

TEMPERATURE IN °C. TO WHICH EXPOSED	FIRST STAGE LARVAE	SECOND STAGE LARVAE	THIRD STAGE LARVAE	FULLY MATURE LARVAE
45	280	320	480	600
46	197	210	294	360
48	106	170	221	300
49	99	130	197	281
50	73	96	112	198
51-52	46	75	91	179
52-53	37	56	71	153
54	23	40	52	121
55	10	22	35	100

Owing to the high temperature in the centre of the fermenting manure, the larvae have been observed to escape to the upper and lateral regions where temperature is favourable and much lower than that of the centre. That was evidently demonstrated by the presence of very considerable numbers of larvae in the surface layers and on the side walls, trying to climb in vain the in-

wardly projecting ledge and finally tumbling onto the heap again, some falling on the floor of the chamber where they are entrapped in the channel and destroyed in the borax solution. Therefore, it has been found essential to turn over the upper layers of the heap daily and bury them into the hot middle region, and thus the larvae are destroyed, those of the first and second stages are instantaneously killed. It has also been observed that although the upper surface of the manure heaps is left exposed, yet no oviposition takes place, being evidently due to the fact that during the process of turning over the fermented manure is brought to the surface, such manure having lost its power of attraction for the ovipositing flies which show a marked repugnance to fermenting manure.

In the course of a few days (about 7 in my case), the process of fermentation is completed, the manure acquiring then a blackish colour and fine texture. The manure is now taken out from the chamber and can be utilized as a land fertilizer. In order to ascertain how flies behave towards this manure after this process, it was exposed in the open and was kept under observation. In nearly all cases no flies were seen on the manure and egg-laying never occurred.

The question naturally arises as to the extent to which the agricultural value of the manure is affected as to the result of the high temperature generated when the manure heaps are closely packed in the manner advocated for the prevention of fly breeding. Parisot and Fernier (1934) in France have pointed out that the high fermentation temperature has no unfavourable influence on the chemical composition and hence on the agricultural value of the manure. Analysis had shown that the manure after the process of close packing and fermentation, is richer in its manurial properties when compared with other manure not treated in the same way. Nitrogen content has been found to be distinctly higher. Similar results have been obtained here by the present author.

It may be here pointed out that the size of the chamber previously described may be subject to variation according to the quantity deposited in different stables. The cost price of the two chambers, although not expensive at all, still may not be within the financial reach of some stable owners, and therefore a simpler though less efficient method may be advotaced for use to keep down the number of flies to a tolerable minimum. A wooden box of about a quarter of a cubic meter (1.00 × 0.50 × 0.50) in size was used. At the floor of this box three or four rounded holes each about 10 cms. in diameter are made and then covered with fine wire gauze. In one of the corners of the stable every day's supply of dung is accumulated in a cone-shaped heap to afford fermentation. On the fourth or fifth day the manure heap is transferred to the wooden box and pressed down against the floor

and sides of the box. During the process of close packing, the liquid manure is drained off through the holes in the floor of the box. The box is then closed and the manure is left to complete fermentation. Every morning the upper layers are turned over and buried in the hot middle regions of the manure to kill any larvae present on the surface. Frequent watering is necessary to promote fermentation. In about five days the process of fermentation is completed, most of the larvae are killed, and then the box is emptied and used again and so on.

The other sorts of stables such as those for cows, buffaloes, calves, sheep, donkeys, etc., play an important part as breeding places for flies. These stables are widely distributed in Egypt, and in most of the cities, provincial towns and all villages they are of common occurrence. It usually happens especially in the country that the cattle sheds, calf pens, donkey stables, etc., are associated with the farmer's house. As previously mentioned, the floor of the stables is usually provided with a thick layer of litter mixed with dung and urine which serves as a bedding for animals. This bedding attracts the ovipositing flies in large number and is a favourable breeding medium for flies. Therefore, the first step which must be taken in order to keep down the number of flies is to change this bedding — which may be preferably formed of straw — every two or three days, and to expose it in the sun to dry so that any eggs or young larvae that may be present will undoubtedly perish from lack of food and unfavourable conditions of humidity.

As to the dung deposited on the floor of the stable, it may be collected and accumulated outside the stable. This dung must not be left a long time but dealt with a shortly as possible to avoid any development of flies. The dung is better made into « dung discs » which will be utilized as fuel after drying them in the sun. Farmers are used to this practice and it is a prevailing habit among them. The common practice of making dung into discs and its importance in the prevention of fly breeding will be discussed later in detail.

B. Dung deposited on farms

Cow and buffalo dung constitute by far the greater part of dung deposited on farms in Egypt. In nearly all the small farms and some of the large ones the practice of making dung into discs — which will be utilized as fuel after drying them — is very common among farmers. The dung is collected and mixed with water, and then made into flat discs each of about 3 cms. in thickness and 40 cms. in diameter. These « dung discs » are then exposed in the sun to dry. The disc takes about two or three days in spring, summer or autumn and about four or five days in winter to become completely dry and ready for use as fuel. This practice is prevalent in Egypt since these

dried discs of dung constitute one of the main sources of fuel in the country. A thorough investigation has been made in the early summers of 1938 and 1939 in order to ascertain any practical importance of this practice of making dung into discs as far as fly control is concerned. Therefore, numerous farms were visited and inquiries made as to the cattle dung. It was found that out of 140 farms visited, there are 128 farms in which the dung is made into discs, while in the remaining farms the dung was stored to be utilized as manure. A large number of newly made « dung discs » were examined every day. In most cases the third stage larvae of flies were found in large numbers, tending to bore downwards in the substance of the disc while some of them were found on the surface of the soil just below the disc. Numerous pupae were also found about one centimetre deep in the soil. In very few cases batches of eggs and first or second stage larvae were met with in the dung of the disc. These discs were kept under observation until they became completely dry. It was found that most of the third stage larvae succeeded to complete development and pupate while the younger larvae or eggs perished. As the discs usually dry up in about two or three days — that is to say long before the life cycle of flies is completed — it is obvious that any eggs or young larvae that may be present in the dung of these discs will undoubtedly fail to develop and will ultimately die through lack of food supply and unsuitable conditions of humidity. But, as the third stage larvae pupate nearly at the time by which the disc is about to become dry, it is obvious that in this case the life cycle of the fly is completed and the adult emerges. Unfortunately, this latter case is the one that prevails owing to the fact that the farmers accumulate the dung and allow it to remain about three or more days until it becomes of a moderate size and then made into discs. It is evident that during these three days in which the dung is accumulated in the open, the females are attracted in large numbers for laying eggs which subsequently hatch and reach the third larval instar in the course of about two days. Thus, when the dung is made into discs, it contains a large number of third stage larvae. In a few cases, the dung accumulated on farms was dealt with and made into discs few hours after deposition, and thus the dung was not exposed long enough for oviposition.

Bearing in mind the results obtained from these observations on farms, it has been found that an essential condition must be fulfilled in order to make the common practice of making dung into discs for fuel efficacious in the prevention of fly breeding. This condition is to deal with the dung as freshly as possible. One day (24 hours) must be regarded as a maximum duration in which the dung may be left on farms before making it into discs. In several farms where the practice of making dung into discs was performed by farmers as suggested, the number of flies was remarkably kept down to a tolerable minimum in about one month time.

In most of the large farms in Egypt, the dung is not made into discs but stored to be utilized as manure. The dung is usually collected and accumulated in heaps or rectangular blocks (Fig. 2) which may reach 20 meters long, 10 meters broad and 2 meters high. There may be two or three of such enormous stacks in one farm. The dung, after several months, is utilized as a land fertilizer. As such heaps or stacks are left exposed and furnished daily with fresh dung deposited on the surface, they become very attractive for the egg-laying females and afford a suitable breeding media for flies as well.



Fig. 2. — A heap of cow and buffalo dung mixed with horse manure.

In order to deal with such heaps of dung, several attempts were made using the biothermic method but the results obtained were very unsatisfactory and the method proved very unsuccessful in this case. It was attributed to the fact that the temperature generated in heaps of cow or buffalo dung during the process of fermentation is not sufficiently high to kill the eggs, larvae or pupae. Several measurements were taken and the maximum temperature recorded was about 30° C. Such temperature is undoubtedly not fatal but, on the contrary, favourable for development. In some farms the dung heaps may consist of an admixture of cow and buffalo dung to other kinds of manure such as that of horse, donkey, etc. This will also tend to lower the general temperature and thus make Roubaud's biothermic method impossible. Means of increasing the heat of the fermentation such as close packing were tried but also proved impracticable owing to the high water content and fine texture of the dung.

The best method which may be advocated for use on the large farms in

Egypt and which gives very satisfactory results in the prevention of fly breeding as proved by my observations and experiments may be described as follows:

The dung is collected and accumulated on the farm (it is better to avoid the enormous increase in size of the dung heap by making smaller heaps in order to facilitate the measures to be carried out). Then a solution of borax (1.5 ounces of borax dissolved in 2.5 gallons of water) is sprinkled over the surface of the heap in ordrer to kill any fly larvae present in the dung. Borax is very cheap and easily obtainable and it does not affect the manurial properties of the dung so long it is used in moderate quantities. But as there is always a daily supply of fresh dung thrown on the surface of the heap, then there is also a continuous source of attraction for the ovipositing females since these are only attracted by the fresh dung. Flies show a marked repugnance to even one day old cow dung. If advantage is taken of this peculiarity of flies and if instead of throwing the fresh dung on the surface of the manure heap it is buried in its inner layers in the centre, oviposition will be considerably reduced as the surface layer will be mainly constituted of old dung and provided with a hard thin crust. In addition to this precaution of burying the fresh dung inside the manure heap, covering with a thick layer of dry soil spread all over the exposed surface of the manure heap is of great use in preventing the flies from oviposition or even from gaining access to the manure heap.

This procedure, if carefully followed and conscientiously undertaken, gives very satisfactory results, and moreover it is simple, easy to carry out, and nearly costless.

C. Accumulations of human excrement exposed in the open

It has been previously pointed out that the lack of the water carriage system in the country and several districts of some provincial towns, and the presence of the conservancy methods of sewage such as privy middens, cesspits, latrines, etc., constitute the greatest menace to the public health and have rendered human excrement very important from the practical point of view. In several villages there are no water closets of any sort in the houses. The faeces are accumulated in the open in heaps which gradually grow by daily additions of fresh excrement, and besides their danger as a source of infection, they are a favourite breeding medium for flies.

The treatment of human excrement with an insecticidal substance was adopted with a view of destroying any larvae living inside as well as preventing any flies from oviposition on the surface. Several chemical compounds have been tested for their larvicidal power. Chloride of lime (bleaching powder), kerosene, phenol, iron sulphate solution, borax (sodium borate in

the crude form) were all tested. It has been found that some of these compounds, namely kerosene and phenol, are unsuccessful when applied on a large scale, for a considerable proportion of larvae escaped injury. Even had all the larvae been killed the cost of the treatment would be prohibitive. Chloride of lime usually yields very good results and in one of the experiments in which this insecticide was scattered on the excrement a greatest mortality was recorded and the smell of the chlorine given off by the lime prevented the flies from gaining access to the excrement for oviposition. But the most efficient insecticide which may be strongly recommended for its marked larvicidal power as well as to its cheap price is borax. About one eighth of a pound dissolved in one gallon of water and sprinkled all over the exposed surface of the human excrement gave the best results in my experiments. After treating the excrement with borax solution, it is preferable to cover the surface with a thick layer of earth which mostly prevents the smell of the excrement from exercising its influence in the attraction of ovipositing flies. But it should be emphasized that, in order that the application of the chemical method yields the most satisfactory results and is carried out with a marked success, it should be in the hands of capable and conscientious people and not left for the farmers or villagers to undertake. Therefore, the authorities with their organized efforts can take up this work.

Other measures

It is now obvious that the different measures of fly control which I have applied were mainly directed to the stable refuse, dung deposited on farms and to the accumulations of human excrement as these constitute the most important breeding places of flies under natural conditions prevailing in Egypt. But it should be borne in mind that in order to obtain the best possible results in the suppression of flies and keep down their numbers to a minimum, the other breeding media such as domestic organic refuse accumulated in dumps, contents of cesspits, faeces promiscuously deposited in open yards, masses of fowl dung in the farmer's house, dead bodies of animals, etc., have to be taken into consideration. The best applicable measures as far as these breeding media are concerned are the preventive measures. The prompt destruction of garbage heaps and house refuse by means of an incinerator is the most preferable measure which will prevent their being a public nuisance and a serious breeding media for flies. The disposal of the contents of cesspits must be carefully undertaken. The dumping place should be outside the town or village about one kilometer distant, and should not be windward. Sewage should be at once covered by a good thickness of dry soil. The regular cleaning, the removal of faeces promiscuously deposited on roads, yards, etc., the removal of the dung of fowls and

other birds usually accumulated in the country houses, and the immediate burial of dead animals are necessary requirements for combating the flies and must form with the other measures an integral part of any sanitary system.

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Notes sur quelques *Cerceris* de la faune égyptienne

[Hymenoptera : Sphegidae]

par le Dr. A. HONORÉ

Le Dr. A. Mochi a publié en 1939, dans le Bulletin de la Société Fouad Ier d'Entomologie [volume XXII, 1938, pages 136-229], sous le titre « Revisione delle Specie egiziane del Genere *Cerceris* Latr. », une étude certainement intéressante en elle-même, mais restant bien loin en-deçà du but que l'auteur a dû se proposer.

Evidemment, les descriptions in-extenso des espèces sont très complètes, les planches noires et en couleurs, exécutées d'après les dessins originaux de l'auteur, sont remarquables ; mais tout cela n'est pas une « Révision » des espèces égyptiennes du genre, c'est une étude détaillée des espèces anciennes et nouvelles connues de l'auteur. Celui-ci semble faire preuve d'une indifférence presque complète vis-à-vis des travaux de ses devanciers, négligeant les synonymes acquis ou à établir, passant même sous silence des espèces qui doivent bien se retrouver un jour, comme par exemple *Cerceris Schmiedeknechti* décrit par F. F. Kohl en 1898, sur des insectes recueillis par le Dr. Schmiedeknecht à Hélouan !

Voici, dans l'ordre chronologique, la liste des espèces décrites ou citées d'Egypte et de la région Sinaïtique, ainsi que les synonymes connus ou établis, sans tenir compte des espèces nouvelles du Dr. Mochi.

Spinola (1838) décrit *rutila* ♀, dont *rubecula* Schlett. ♀ est un synonyme ; le mâle de *rutila* a été décrit par Klug sous le nom de *excellens*. Spinola décrit encore *tricolorata*, *Fischeri*, *Waltli*, *chlorotica* et *flaviventris*. Ce dernier nom étant preoccupé (Van der Linden, 1829), Klug le changea en celui de *Spinolica*. Les trois dernières espèces doivent tomber dans l'oubli, faute de pouvoir être identifiées avec certitude.

Dahlbom (1843-1845) décrit *erythrocephala* ♀, dont *nasuta* ♀ Lep. (1845) est un synonyme probable. *Erythrocephala* ♀ Schlett. (1887) est une tout autre espèce. Le mâle certain de *erythrocephala* Dlb. a été décrit par

Kohl qui considère *selifera* Schlett. (1887) comme un synonyme très probable.

Les trois autres espèces de Dahlbom, *histrio*, *dispar* et *solitaria*, sont vouées à disparaître de la nomenclature.

Klug (1845) décrit *pulchella*, *histrionica*, *vidua* ♂, *insignis* ♀ et *annulata* ♀ ; Schletterer (1887) redécrit *annulata* ♂ et ♀ en changeant le nom en celui de *Klugi*, l'autre étant préoccupé par Rossi (1794). Il y a encore *albicincta* ♀ Klug, dont le mâle sera décrit par Schletterer.

Lepeletier (1845) décrit *capito;* il cite *fasciata* Spin. (probablement synonyme de *arenaria* L. et qui n'a d'ailleurs pas été retrouvé).

Walker (1871) décrit *contigua* ♂ ♀ et *alboatra* ♂, dont la femelle sera décrite par Mochi.

Taschenberg (1875) décrit *lutea* ♀, dont le ♂ sera décrit par Schletterer.

Morawitz (1883) décrit *orientalis* ♀, déjà employé par Smith (1856) et changé en *eugenia* par Schletterer.

Radoszkowski (1886) décrit *Komarowi* ♀ (qui sera retrouvé en Egypte). Morice (1897) décrit le mâle de *Komarowi* sous le nom de *hirtiventris*. Ce n est qu'en 1911 qu'il décrit le mâle sous son véritable nom, mais sans en reconnaître la synonymie.

Schletterer (1887), indépendemment des changements de noms indiqués ci-dessus, décrit *subimpressa* ♂ ♀, *chromatica* ♀, *nilotica* ♂ (= *lutea* Tasch.).

Morice (1897) décrit *pallidula* et *pruinosa*.

Kohl (1898) décrit *pharaonum* et *Schmiedeknechti*.

Nous avons ainsi au total une quarantaine de noms spécifiques, dont : 20 espèces valables et certaines pour la faune ; 5 espèces signalées, suffisamment bien décrites pour pouvoir être identifiées par la suite ; 8 synonymes établis ; 7-8 espèces qui, en l'absence des types, devront bien disparaître, faute d'une description suffisante.

Le Dr. Mochi, dans sa « Revisione », cite et décrit 18 espèces, dont : 13 espèces déjà décrites sur un des sexes au moins, et dont 2 signalées pour la première fois en Egypte (*Komarowi* et *Döderleini*) ; 5 espèces nouvelles (*sulcipyga*, *Priesneri*, *Alfierii*, *lateriproducta*, *Honorei*), plus 3 variétés nouvelles.

2 espèces sont vaguément citées (*emarginata* Panz. et *lunata* Costa) et 4 espèces sont définitivement abandonnées.

Faisant abstraction des espèces nouvelles décrites, et des espèces citées pour la première fois, le Dr. Mochi retient ou fait mention de moins de 20 noms, moins de la moitié des noms connus avant la publication de sa « Revisione » !

Il n'entre pas dans mes intentions de refaire ab ovo le travail du Dr. Mochi, mais simplement de relever les omissions et les erreurs d'interprétation de l'auteur. J'en commettrai peut-être moi-même ; j'espère que l'on voudra bien ne pas m'en tenir rigueur : il n'est pas de censeur infaillible.

Pour éviter toute amphibogie, je dois préciser le sens de certains termes.

Le pronotum n'est visible en dessus que par sa tranche postérieure appliquée au bord antérieur du mésonotum. Beaucoup d'auteurs emploient un terme abbréviatif, inexact mais commode, *collare*. On pourrait dire en français *collier* ou *collet ;* je préfère encore dire *bord postérieur du pronotum* ou *pronotum* tout court.

Segment médiaire : Cette vieille dénomination due à Latreille a le grand mérite de correspondre aux apparences et d'être exacte en fait. Par contre, le terme métathorax à proprement parler est inexact. Le segment médiaire est formé par la soudure intime d'une partie du métathorax avec le premier segment (embryologique) de l'abdomen ; il comprend tout ce qui est postérieur au postscutellum jusqu'à l'articulation avec l'abdomen.

L'*aire cordiforme*, espace généralement bien délimité occupant le centre de la partie supérieure du segment médiaire, affecte, dans le genre *Cerceris*, sauf de rarissimes exceptions, une forme triangulaire dont la base est appliquée au postscutellum. Il serait plus simple de l'appeler « aire triangulaire », et certains font ainsi, mais l'usage de l'appeler « aire cordiforme » s'étant maintenu, continuons aussi.

Le premier segment visible de l'abdomen, plus ou moins rétréci par rapport au suivant, porte le nom de *pétiole*. D'après les données embryologiques, il serait le deuxième segment abdominal, le premier étant soudé avec les pièces formant le segment médiaire. Mais ceci ne cadre pas avec la morphologie extérieure actuelle, sur laquelle est basée la systématique. Je sais bien que certains trouveront à y redire, mais je ne puis me résoudre à appeler deuxième segment ce qui est en fait le premier visible.

Je terminerais ce préambule par un conseil d'ordre pratique.

Le flacon au cyanure est un mauvais procédé de chasse pour les hyménoptères à bandes ou taches jaunes ou blanches : ces couleurs virent au rouge sous l'influence des vapeurs de cyanure. On a beaucoup prôné, dans ces trente dernières années, pour remplacer le cyanure, l'éther acétique ou acétate d'éthyle, qui modifie moins les couleurs, et a de plus l'avantage de ne pas raidir les articulations. Néanmoins, ce procédé présente malgré tout un inconvénient sérieux : les blancs d'ivoire et les blancs jaunâtres de certaines espèces tournent au jaune franc si le contact des insectes avec les vapeurs d'éther acétique se prolonge un peu trop, une matinée de chasse par exemple ; ainsi pour *lateriproducta* qui est d'un blanc d'ivoire et rouge clair sur fond noir, et non jaune, comme le dit Mochi ; ainsi encore, le cinquième segment

abdominal chez *Fischeri* femelle n'est pas jaune comme les précédents mais d'un blanc éclatant qui fait reconnaître l'espèce à première vue. J'ajouterais incidemment que pour les Hyménoptères très poilus, comme les Apides, l'éther acétique ne vaut rien.

Le seul procédé de chasse qui m'ait donné satisfaction est l'éther sulfurique (ou éther ordinaire) très pur, déjà recommandé depuis bien longtemps par Friese et Schmiedeknecht, adopté par Morice, Kohl et bien d'autres.

Il est volatil, c'est entendu ; il faut recharger de temps en temps le flacon de chasse, ou mieux encore, en avoir de réserve, donner le « coup de grâce » à la fin de la chasse, mais les résultats comme tenue des couleurs et facilité de préparation sont inégalables.

Je voudrais bien ajouter à la Bibliographie donnée par le Dr. Mochi les ouvrages suivants :

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Lucas (1849) : Exploration scientf. de l'Algérie, tome III et Atlas.
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Taschenberg (1875) : Zeitschr. f. d. Gesamm. Naturwissensch.
Morawitz (1883) : Mag. Akad. Term. Ertek, Vol. XIII.
Radoszkowski (1886) : Horae Soc. Ent. Rossicae.

Cerceris erythrocephala Dahlb., 1845 (non Schletterer, 1887).

Schletterer a déjà corrigé lui-même son erreur dans le « Supplément à sa Monographie » en 1889. Morice relève aussi l'erreur, mais il en commet une autre en considérant cette espèce comme une variété de *tuberculata* Vill. Il a eu en main, sans le décrire, le mâle de coloration normale, et aussi un mâle de coloration semblable à celle de la femelle. Kohl a repris la question dans son « Mémoire sur l'Expédition à Socotra », en 1907, où il décrit le mâle certain en se basant sur des exemplaires capturés en Egypte en même temps que la femelle ; *selifera* Schlett. est un synonyme presque certain.

Des formes de passage existant entre le mâle jaune et le mâle noir, il n'y avait guère d'utilité à affubler cette variation du nom de *gynochroma* ; pourquoi ne pas se contenter de *aberratio feminae colore* ?

Cette même espèce avait encore été décrite, en 1845 également, par Lepeletier sous le nom de *nasuta* ♀ et Lucas en a donné une figure coloriée dans son « Atlas de l'Exploration de l'Algérie ». Une question de priorité assez épineuse aurait pu surgir, mais par bonheur *nasuta* a déjà été employé par Latreille en 1809, pour *labiata* Fab.

Ne pas confondre avec *nasuta* Dahlb. (= *quinquefasciata* Rossi).

Espèce xérophile. Je ne l'ai pas trouvée dans les zones cultivées.

Cerceris capito Lep.

Contrairement à l'espèce précédente, j'ai pris celle-ci très communément dans les zones de culture (Hawamdieh, Tarfaia, Mazghouna, etc.), principalement sur les inflorescences de poireaux et d'oignons.

Cerceris rutila Spin., 1838 (*rubecula* Schlett., 1889, non *rubecola* comme l'écrit Mochi ; ♂ = *excellens* Klug.

J'ai pris quelques exemplaires des deux sexes en Février, à Hawamdieh, les femelles sur le réséda cultivé, les mâles volant sur les plantes basses, sans marquer de préférence.

L'insecte qui a servi de type pour la description du mâle (Dr. Mochi) n'a pas d'autre origine. Ce sexe n'était pas véritablement inédit : il y avait longtemps que je le possédais dans ma collection sous le nom de *excellens* Klug ; les termes de la description de Klug s'adaptent parfaitement aux individus en question. N'ayant pas pris les deux sexes ensemble, j'avais toujours hésité quelque peu à les réunir, tout en considérant leur parenté comme très probable.

Le dessin du clypeus de la femelle donné par le Dr. Mochi (figure 4 de la planche VI), vu de face, n'est pas exact : la partie médiane surélevée n'est pas aussi détachée que l'indique la figure, et les côtés de la plaque forment un angle plus ouvert et à bord droits.

Cerceris Komarowi Radoszk., 1886 ♀ (♂ exclus?) ; ♂ Morice, 1911 (*hirtiventris* Morice, 1897).

Le Dr. Mochi l'a indiqué comme trouvé par moi à Sakkarah et à la bordure du désert ; en réalité les nombreux spécimens que j'ai capturés proviennent de Hawamdieh. Les femelles ont un vol puissant et soutenu, très caractéristique, ressemblant beaucoup à celui des grands odonates inspectant au vol leur terrain de chasse.

Cerceris lutea Taschenb., 1875 (♀ seulement).

Le mâle décrit par Taschenberg et repris par la suite par André, n'est certainement pas le vrai mâle décrit par Schletterer sous le nom de *nilotica*. Assez répandu aux environs du Caire, les mâles étant beaucoup plus fréquents que les femelles.

Cerceris pruinosa Morice, 1897 (*pallidula* Morice, 1897, et *pulchella* Klug, 1845).

C'est très probablement dans ce petit groupe que devraient se loger les trois espèces jaunes de Spinola : *chlorotica*, *Waltli* et *flaviventris* (*Spinolica*), que nous pouvons considérer comme perdues faute des types. *Flaviventris* pourrait bien être *pallidula*, et *chlorotica* serait la *pulchella* ?

Cerceris alboatra Walker, 1871 et **Cerceris vidua Klug, 1845.**

Le Dr. Mochi décrit la femelle «inedita» de *Cerceris alboatra*, ou du moins ce qu'il considère comme telle, car l'auteur ne disposant que d'un seul exemplaire, émet quelques doutes sur la légitimité de la réunion des deux sexes.

En fait, l'attribution est exacte. J'ai pris assez communément les deux sexes ensemble, à Hawamdieh, de Mai en Juillet, sur les inflorescences de poireaux et d'oignons. Dès 1924, j'avais capturé isolément les premières femelles que je considérais comme étant *vidua* Klug ♀ (1), avec un certain doute cependant, la description de Klug se rapportant au mâle, et ne comportant que des couleurs sans aucun détail de structure; plus tard la capture d'un exemplaire ♀ de *Cerceris insignis* Klug me fixa, car la description de *insignis* faisait état de la sculpture caractéristique de l'aire cordiforme du segment médiaire.

Morice, en 1897, a eu en mains sans le reconnaître, le mâle de *alboatra* Walker; la description qu'il en donne ne laisse aucun doute à ce sujet, mais, se basant sur une opinion émise par Kohl, il croyait avoir affaire à *vidua* ♂, et en complète la description. Or, assimiler *alboatra* à *vidua* ne me paraît pas acceptable : Walker cite un caractère décisif que ni Kohl ni Morice n'auraient dû négliger : « the petiole is much more slender than that of *vidua* ».

Cerceris vidua Klug doit être autre chose, d'allures générales semblables à celles *d'alboatra*, sauf en ce qui concerne le pétiole (et peut-être d'autres caractères).

Je crois bien avoir retrouvé cette espèce dans une série de mâles, une douzaine environ, du Gebel Asfar, en Avril-Mai.

Noir, avec les dessins du corps blanc-jaunâtres et la coloration des pattes semblables à ceux de *alboatra*.

Pétiole noir, très peu plus long que large. L'ensemble du corps d'allure moins élancée que *alboatra*. Hanches antérieures normales.

Clypeus pentagonal, nettement bombé au milieu. Yeux paralèlles. Le deuxième segment est moins étiré à la base; il n'y a pas de plaque basilaire ventrale, mais un très léger renflement nodiforme mal délimité. Avant-dernier sternite denticulé, par contre, le tergite correspondant ne porte pas de dent latérale.

Ponctuation générale assez forte et plutôt serrée, sauf sur le mesonotum et le scutellum, qui sont même assez brillants chez quelques individus. L'aire

(1) Dans le catalogue de Dalla Torre, il y a l'indication suivante que je n'ai pu contrôler : *C. vidua* Ritsema, Tidjschrift voor Entomologie, 1874, p. 298, numéro 17, ♀.

cordiforme me paraît caractéristique : elle est lisse sur la surface et présente le long de la base une bande régulière de hachures courtes et serrées, comme on en voit chez *tricolorata* Spin. d'après la figure 17 de la planche X de Mochi, mais plus large, au moins un quart de la hauteur du triangle.

Ce ne peut être *tricolorata* elle-même : celle-ci a une plaque basilaire petite mais bien marquée au deuxième sternite ; d'après la figure la surface de ce sternite n'est pas marquée de gros points sur le disque ; le pétiole est plus large que long, et la ponctuation est très espacée sur le dos du thorax ; subsidiairemnt, le nombre des bandes jaunes à l'abdomen est différent, ainsi que l'importance du développement de la coloration rouge.

Il y a une variation à pétiole rouge, chez laquelle les bandes claires sont encore plus blanchâtres que chez les individus à pétiole noir. A première vue elle a un autre aspect, mais aucun caractère spécial ne permet de la séparer de la forme à pétiole noir. Peut-être avons-nous là *contigua* Walker?

A vrai dire, l'assimilation de cette espèce à *vidua* Klug n'est rien moins que prouvée ; elle est « probable » à mon avis et rien ne s'y oppose, mais on pourrait tout aussi bien l'affubler d'un nom nouveau.

En l'absence du sexe femelle, je préfère ne pas surcharger la nomenclature d'un synonyme possible ; jusqu'à preuve du contraire, je considère cette espèce comme étant *vidua* Klug (avec un point d'interrogation).

Cerceris insignis Klug.

Décrit de « l'Arabie heureuse ». J'en ai pris une femelle, en Juillet, à Hawamdieh, sur les inflorescences de poireaux, en même temps que *alboatra* Klug. L'exemplaire correspond bien à la description : répartition des colours, pilosité blanche longue et bien fournie. L'aire cordiforme du segment médiaire pourrait peut-être ne pas correspondre exactement, mais ceci me paraît plutôt une question d'interprétation des termes employés.

La description dit : « Metathorax sanguineus, plaga baseos triangularis media laevi, basi longitudinaliter elevato-lineata, nigra ». Dans l'insecte en question, l'aire triangulaire est rouge, lisse dans sa moitié postérieure (vers la pointe), marquée dans sa moitié basilaire de 7 à 8 sillons, disposés en long et de dimensions inégales, et qui vues sous un certain angle paraissent être, non pas des sillons, mais de fines carènes paralèlles, dont les intervalles feraient figure de sillons.

Morice, en 1911 redécrit *Cerceris insignis*, en lui assimilant, comme synonyme douteux, *tricolorata* Spin.. En réalité, *insignis* sensu Morice est la vraie *tricolorata*, telle que le Dr. Mochi l'a comprise et décrite.

Pour moi, *insignis* ♀ Klug ne serait pas autre chose qu'une variation sexuelle d'*alboatra*. Aspect général, structure des pattes, ponctuation, et surtout la forme très spéciale du pénultième segment ventral, les arguments ne manquent pas pour justifier cette réunion, d'autant plus que parmi les nom-

breux specimens de *alboatra* qui m'ont passé sous les yeux, j'ai pu constater la présence de formes indiquant une tendance au développement de la coloration rouge sur le segment médiaire et sur le pétiole. Les deux seuls caractères différentiels resteraient la pilosité beaucoup plus abondante que chez les exemplaires les plus frais de *alboatra* et les détails de sculpture de l'aire cordiforme.

On peut donc considérer *insignis* Klug comme une variation de *alboatra;* seulement alors, de par les lois de priorité *insignis* deviendrait nom spécifique, et *alboatra* serait ramené au rang de variété; or, *alboatra* est certainement mieux et plus sûrement connu que *insignis*, encore une de ces conclusions contraires au bon sens auxquelles nous mène l'application aveugle des dites lois.

En attendant, le bon sens bénéficiera du point d'interrogation dont nous pouvons, jusqu'à plus ample informé, gratifier la synonymie en question.

Cerceris Honorei Mochi.

Je puis donner la description du mâle, resté inconnu au Dr. Mochi.

♂.— Long. : 7,5 à 8,5 mm.

Noir, à premier segment abdominal brun rouge clair. Sont colorées en jaune franc les parties suivantes : la face, les mandibules (à pointe rembrunie), le bord interne des yeux et la carène inter-antennaire, le scape des antennes, et le dessous du funicule (le dessus est rougeâtre), deux points derrière les yeux ; le pronotum, les écaillettes, deux taches mésosternales, le scutellum et le post-scutellum, deux grandes sur la partie déclive postérieure du segment médiaire ; une petite tache transversale au bord postérieur du postérieur du pétiole, une bande basilaire au deuxième segment, les troisième, cinquième et sixième en entier, les bandes des deuxième et troisième segments se continuant sur la face abdominale.

Pattes jaune clair, les fémurs postérieurs plus ou moins rembrunis, les intermédiaires légèrement teintés.

Cette coloration est constante, sauf les taches mésosternales qui disparaissent chez 2 des 6 individus examinés.

Ailes enfumées dans leur tiers terminal, à partir de la deuxième cubitale.

Clypeus non aplati, plutôt bombé ; yeux légèrement divergents vers le bas ; carène inter-antennaire bien marquée.

Pronotum comme chez la femelle, avec la petite épine à l'angle latéro-inférieur. Ponctuation marquée, mais assez éparse pour laisser les téguments plus ou moins brillants, surtout le scutellum et le post scutellum qui peuvent être lisses, le segment médiaire également assez brillant. Aire cordiforme en

triangle aigu comme chez la femelles, lisse, avec un sillon médian bien marqué.

Pétiole très allongé, deux fois plus long que large, brillant, à ponctuation eparse ; celle-ci est plus dense sur le dessus de l'abdomen, tout en n'étant pas très serrée ; le dessous de l'abdomen est peu ponctué, le deuxième sternite étant même presqu'entièrement lisse. Deuxième segment étiré en col comme chez *alboatra;* plaque basilaire du deuxième sternite petite mais bien marquée. Avant-dernier degment non denticulé. Aire pygidiale légèrement échancrée à son extrémité.

Type : Hawamdieh, en Mai.

La longueur inusitée du pétiole rapprocherait cette espèce de *alboatra;* mais, en dehors de l'aire cordiforme, la présence d'une plaque basilaire au deuxième sternite et l'absence des épines latérales du pénultième sternite l'en éloignent nettement.

Je possède de cette espèce trois individus femelles très intéressants. L'un présente une coloration très semblable à celle décrite par le Dr. Mochi, qui a vu l'insecte et confirmé la détermination. Les deux autres ont une coloration identique à celle des mâles, telle qu'elle est détaillée plus haut (une de ces femelles a également été déterminée par l'auteur lui-même). Donc, sur 9 exemplaires des deux sexes, un seul, une femelle, correspond au type unique décrit.

Or, précisément ce spécimen m'avait toujours intrigué. Je possédais cette femelle depuis bien longtemps (6 Juin 1924) et je la considérais comme pouvant être *histrionica* Klug. La correspondance des couleurs est très exacte, et Klug la déclarait « *Philantho fisheri* Spin. proximus » (*Philanthus* pour *Cerceris*). En effet, il y a une certaine ressemblance, mais assez vague.

Je m'étais heurté à une phrase de la description de Klug : « punctis plurimis sat magnis impressis scaber » (scaber = rugueux) ; il n'y a pas de *Cerceris* de ce groupe qui soit rugueux de par la ponctuation, aussi ai-je toujours supposé qu'il y avait là un lapsus calami de la part de Klug ; peut-être un jour trouvera-t-on que *Honorei* = *histrionica* Klug.

Quoi qu'il en soit, j'en possède 9 individus, 3 ♀♀ et 6 ♂♂, de Hawamdieh, en Avril-Juin, sur les inflorescences du fenouil cultivé (*Fœniculum capillaceum* Gilib.).

Cerceris subimpressa Schlett., 1887.

Le Dr. Mochi a méconnu cette espèce, probablement parce qu'il la connaissait mal en nature, et l'a réunie à *Cerceris Fischeri*. Il dit s'être basé sur la comparaison et l'étude des descriptions, mais comment a-t-il pu assimiler une espèce à yeux divergents avec une autre à yeux paralèlles ?

Cerceris subimpressa n'est pas une espèce xérophile, ni même du désert

en bordure des régions cultivées, comme Sakkara par exemple ; elle me paraît se rencontrer exclusivement dans la zone des cultures ; les nombreux exemplaires que j'ai pris viennent tous des jardins et terrains cultivés autour de Hawamdieh, où cette espèce, qui doit être hygrophile, trouverait les conditions d'existence voulues ; la plante favorite, pour ne pas dire exclusive, est la « libia » (*Lippia nodiflora* Rich.).

Voici d'abord le système de coloration.

♀.— Noire, marquée de jaune, le pétiole noir. Sont de couleur jaune franc les parties suivantes. La face, les mandibules (à pointe rembrunie), les orbites internes des yeux et la carène inter-antennaire ; le scape des antennes (le funicule étant orangé clair en dessous et brun-rouge en dessus) ; deux taches de chaque côté du pronotum, les écaillettes. le post-scutellum ; une grande tache basilaire au deuxième segment de l'abdomen, le troisième jaune en entier, moins une échancrure en demi-cercle au bord antérieur, le cinquième segment jaune en entier ; la bande jaune du troisième segment se continue en dessous sur toute la surface du sternite, les quatrième et cinquième sternites ne sont que tachés de jaune sur les côtés.

Pattes d'un jaune légèrement orangé, l'articulation des fémurs postérieurs avec leur tibia est brun-noir.

♂.— Comme la femelle, mais d'un jaune plus clair ; sixième segment jaune en dessus ; sur la face ventrale de l'abdomen, la bande jaune correspondant à celle du troisième segment subsiste seule, les taches latérales des quatrième et cinquième sternites ont disparu ; les fémurs postérieurs sont d'un brun-noir sur toute leur face interne.

Ailes légèrement teintées sur leur surface, quelque peu rembrunies le long du bord antérieur et à la pointe.

La variation de coloration est nulle chez les 9 mâles de ma collection, minime chez la femelle, elle se borne à l'apparition d'un mince trait jaune, pouvant encore être scindé en deux taches sur le scutellum, et, très rarement, quelques petites taches jaunes sur le bord postérieur du quatrième segment de l'abdomen. En tout cas, parmi les nombreux exemplaires examinés, je n'en n'ai pas trouvé un seul ayant le pétiole rouge, par contre, tous les *Fischeri* que j'ai vus, une cinquantaine au moins, tous avaient le pétiole rouge. Encore ceci : chez *Fischeri* ♀, la bande colorée du cinquième segment n'est pas jaune mais d'un blanc d'ivoire ; sur le vivant la différence est très nette et permet de reconnaître l'espèce au premier coup d'œil. Sur les insectes tués au moyen du cyanure ou de l'acétate d'éthyle (employé par le Dr. Mochi) ce blanc tourne au jaune, et cela change complètement l'aspect de l'insecte. L'expérience m'a appris que les blancs et les jaunes blanchâtres des Sphégides et des Vespides sont sensibles à l'influence de l'acétate d'éthyle qui les jaunit, surtout si le contact est quelque peu prolongé.

Le système de coloration présente donc des différences constantes entre les deux espèces : il suffit de comparer une vingtaine de *subimpressa* avec une série pareille de *Fischeri* pour être édifié.

En dehors des différences de coloration, il y a encore assez de caractères de structure permettant de distinguer les deux espèces. Ci-après un tableau comparatif donnant les caractères essentiels.

Cerceris subimpressa	*Cerceris Fischeri*
♀	♀
Bord internes des yeux divergents vers la base.	Bords internes des yeux paralèlles.
Face sous les antennes plus large que haute.	Face sous les antennes aussi haute que large
Aire cordiforme bien délimitée. Sillon médian et bords latéraux marqués par de microscopiques hachures.	Aire cordiforme, pourvue de sutures latérales peu marquées, ainsi que que le sillon médian.
Région du segment médiaire bordant l'aire cordiforme à ponctuation de densité moyenne, égale à celle du restant du segment. Aspect peu brillant.	Région du segment médiaire bordant l'aire cordiforme à ponctuation très espacée. Aspect très brillant.
Deuxième sternite imponctué au milieu, devant la plaque basilaire.	Deuxième sternite ponctué à gros points allongés sur toute la surface.
Protubérances latérales du cinquième sternite arrondies en bosses, séparées par un bord droit.	Protubérances latérales du cinquième sternite proéminentes en dehors, presque pointues, séparées par un sinus.
♂	♂
Avant-dernier sternite simplement anguleux sur les cotés.	Avant-dernier sternite nettement denté, les dents visibles par dessus.

Les femelles sont faciles à distinguer, les mâles le sont moins. Chez ceux-ci, les caractères de structure sont moins nets, mais en dehors des angles plus ou moins émoussés du sixième sternite, il reste toujours pour caractériser *subimpressa* l'aire cordiforme moins lisse et mieux définie, surtout le sillon médian plus profond ; aussi la largeur relative de la face et dans une certaine mesure, la coloration noire du pétiole.

Hawamdieh, assez commun de Mars en Mai, sur *Lippia nodiflora* Rich.. *Fischeri* se prend dans les mêmes endroits, mais plus tard dans la saison,

en Mai-Juin, volant plutôt sur certaines Labiées odoriférantes, le basilic (*Ocimum basilicum*) et le romarin (*Rosmarinus officinalis*).

Cerceris Klugi Schlett., 1887 (*annulata* Klug, nec Rossi).

Cette espèce est décrite d'Assouan.

J'en ai pris une femelle à Sakkarah, le 1er Juin 1934. Elle correspond bien à la description que donne Schletterer, sauf en ce qui concerne les bandes jaunes des troisème et quatrième segments dorsaux de l'abdomen, qui sont ici très larges sur les côtés, mais nettement interrompues au milieu, alors que Schletterer les dit plus ou moins échancrées.

Ce système de coloration dans lequel chez la femelle, tous les segments, depuis le deuxième, et le quatrième y compris, portent une bande jaune, est tout à fait anormal pour l'Egypte. Dans le même genre, il y a *Schmiedeknechti* Kohl, mais ici le clypeus a une forme assez particulière, et le pétiole est beaucoup plus large; il pourrait y avoir certaines formes à bandes jaunes réduites de *Cerceris Alfierii*, mais cette espèce a des hanches coniques très caractériques, alors que *Klugi* ou tout au moins le spécimen que j'ai sous les yeux, a les hanches normales, tronquées carrément.

Quant au mâle, je suis bien dans le doute; le Dr. Mochi a inséré, sans commentaires, dans sa table de détermination, une espèce qu'il suppose être *Klugi* ♂; il est regrettable qu'il n'ai pas cru devoir en donner une description un peu plus substantielle.

Je possède 2 mâles de Hawamdieh qui ressemblent étonnement à la ♀ dont il est question ci-dessus; je ne crois pas que l'on puisse l'assimiler à cette espèce, car Schletterer dit expressément : « Segmenta abdominis ventralia lateraliter evidenter angulata » (tous les segments), ce qui ne se vérifie nullement sur mes specimens. Ce n'est pas *emarginata* Panz., bien qu'ils y ressemblent. Peut-être y a-t-il là une espèce nouvelle.

Cerceris lateriproducta Mochi.

Hawamdieh, 4 ♀♀ et 3 ♂♂ en Juin; une ♀ en Septembre. Je cite cette espèce surtout pour relever le fait que la figure coloriée N° 14 ♀ de la planche II du Dr. Mochi n'est pas très fidèle : les dessins jaunes du corps, (à l'exclusion des pattes) ne sont pas jaunes, mais d'un blanc d'ivoire, ce qui donne à l'insecte un aspect tout différent.

Cerceris Schmiedeknechti Kohl, 1898, ♂ ♀ (Ann. K.-K. Naturhist. Hofmus. Wien).

Décrit de Hélouan. Le Dr. Mochi n'en fait pas mention. Je ne la connais pas de visu; il faut bien espérer que cette espèce se retrouvera un jour, également *albicincta* Schlett.

Schletterer signale *eugenia* Schlett. (*orientalis* Mor., nec Smith) comme existant en Egypte ; il y a peut-être une erreur.

Quant aux trois espèces de Dahlbom : *histrio, dispar* et *solitaria*, comme les trois espèces de Spinola citées plus haut : *flaviventris, chlorotica* et *Waltli*, on peut les considérer comme étant actuellement indéchiffrables ; je serais assez d'avis de les rayer définitivement.

Ci-après des Tables pour la détermination des espèces égyptiennes, établies d'après celles du Dr. Mochi, avec les quelques modifications rendues nécessaires.

Tables pour la détermination des espèces

♀♀

1. Bord antérieur de la partie médiane du clypeus nettement détaché sur toute ou partie importante de sa longueur, la partie médiane elle-même plus ou moins relevée en auvent ou sous forme d'une crête transversale 2

—. Partie médiane du clypeus à bord antérieur non détaché sur une partie importante de sa longueur, mais pouvant présenter en son milieu des protubérances coniques plus ou moins marquées 3

2. Partie médiane du clypeus libre, relevée en auvent, bombée, épaissie, échancrée en arc à son bord antérieur. Ailes complètement enfumées. Longueur 25-30 mm. .... *erythrocephala* Dhlb.

—. Bord antérieur de la partie médiane du clypeus libre, non apprimé, nettement relevé sous forme d'une crête transversale, la partie médiane elle-même restant aplatie. Ailes légèrement enfumées, obscurcies le long de la côte et au bord antérieur de l'aile. Longueur 10-12 mm. .... *rutila* Spin.

3. Aire pygidiale striée longitudinalement, brillante. Coloration rouge et noire .... *sulcipyga* Mochi

—. Aire pygidiale non striée longitudinalement 4

4. Pénultième sternite portant une impression médiane limitée en arrière par un rebord saillant 5

—. Pénultième sternite sans impression médiane 6

5. Deuxième sternite portant une plaque basale lisse, faisant saillie .... *tricolorata* Spin.

—. Deuxième sternite sans plaque basale ··············· *alboatra* Walk.

6. Angles postico-latéraux des tergites dilatés en un petit appendice aigu.. ·························· 7

—. Angles posticaux-latéraux des tergites droits ou arrondis ············ 8

7. Coloration foncière noire, dessins du corps blancs et rouges ·········· ·························· *lateriproducta* Mochi

—. Coloration jaune dominante ········ *lateriproducta* var. *flava* Mochi

8. Tempes munies en dessous d'une dent spinoïde forte et aiguë ·········· ·························· *Komarowi* Radszk.

—. Tempes inermes ·························· 9

9. Deuxième sternite sans plaque basilaire ·························· 10

—. Deuxième sternite présentant une plaque basilaire, qui peut être très réduite (*pallidula*) ·························· 14

10. Mésopleures sans épine. Taille petite, 7-9 mm. ················ 11

—. Mésopleures armées d'une épine plus ou moins aiguë. Taille dépassant 12 mms. ·························· 12

11. Aire pygidiale en trapèze. Tarses postérieurs courts par rapport à leur tibia ·························· *pharaonum* Kohl

—. Aire pygidiale en ovale allongé. Tarses postérieurs longs par rapport à leur tibia ·························· *pallidula* Morice

12. Clypeus absolument plat. Aire cordiforme lisse, avec un sillon médian. Tarses postérieurs courts par rapport à leur tibia ······· *lutea* Tasch.

—. Clypeus relevé en cône en avant. Aire cordiforme nettement striée sur toute la surface. Tarses postérieurs longs par rapport à leur tibia. .. 13

13. Téguments très finement ponctués. Une seule épine mésopleurale. Tête de largeur normale. Longueur 13 mm. ············ *Döderleini* Schulz

—. Téguments fortement et densément ponctués. Deux épines mésopleurales. Tête de largeur énorme. Longueur 16-20 mm. ······ *capito* Lep.

14. Coloration foncière jaune ·························· 15

—. Coloration foncière noire, à dessins jaunes ou rouges. ············ 19

15. Une épine mésopleurale ·························· 16

—. Pas d'épine mésopleurale 17

16. Partie médiane du clypeus légèrement concave sur les deux-tiers inférieurs. Deuxième article du funicule à peine plus long que le premier .. .. *pulchella* Kl.

—. Partie médiane du clypeus portant une petite bosse en forme de pyramide. Deuxième article du funicule deux fois plus long que le premier. .... *Priesneri* Mochi

17. Clypeus déprimé sur la moitié inférieure de sa surface, légèrement creusé vers son bord antérieur. Hanches antérieures ayant un prolongement conique atteignant, en longueur, presque la moitié du trochanter .... *Alfierii* Mochi

—. Clypeus plus ou moins convexe, non déprimé ni creusé. Hanches antérieures normales 18

18. Clypeus à bord antérieur droit. Plaque basilaire du deuxième sternite très réduite .... *pallidula* Morice

—. Clypeus à bord largement échancré. Plaque basilaire du deuxième sternite bien développée .... *pruinosa* Morice

19. Une épine mésopleurale longue et aiguë. Aire cordiforme allongée, la hauteur du triangle étant beaucoup plus grande que sa largeur à la base. .... *Honorei* Mochi

—. Pas d'épine mésosternale. Aire cordiforme de dimensions normales.. 20

20. Hanches antérieures normales. Des bandes jaunes ou des taches jaunes latérales sur chacun des segments abdominaux .... *Klugi* Schl.

—. Hanches antérieures ayant un prolongement conique (cf. N° 17) 21

21. Deuxième sternite non ponctué sur le disque, devant la plaque basilaire. Aire cordiforme à bords et sillons nettement marqués. *subimpressa* Klug.

—. Deuxième sternite ponctué au milieu comme sur les côtés 22

22. Aire cordiforme bien délimitée, couverte d'un pointillé très fin, mais bien visible, les côtés marqués par de petits sillons transversaux. Coloration générale noire et jaune, pétiole entièrement noir ou taché de jaune. .... *Alfierii* var. *picta* Mochi

—. Aire cordiforme mal délimitée, très lisse, sauf un fin sillon médian. Coloration variée, noire à bandes jaunes, le pétiole rouge, le cinquième segment de l'abdomen blanc.............................. *Fischeri* Spin.

♂♂

1. Clypeus convexe dans sa partie supérieure, avec, dans sa partie inférieure, une forte carène longitudinale bien marquée, atteignant le bord antérieur du clypeus .... *Döderleini* Schulz

—. Clypeus autrement conformé 2

2. Métatarse intermédiaire nettement recourbé. .... *capito* Lep.

—. Métatarse intermédiaire droit 3

3. Cinquième sternite creusé à sa base d'une concavité en demie-lune tournée vers l'arrière .... *Komarowi* Radszk.

—. Pas de concavité en demie-lune sur le cinquième sternite. 4

4. Angles postico-latéraux des tergites légèrement dilatés. 5

—. Angles non dilatés 6

5. Tête et thorax noirs à dessins jaunes; abdomen jaune avec tous les segments offrant une mince bande noire terminale. .. *lateriproducta* Mochi

—. Coloration jaune très dominante .... *lateriproducta* var. *flava* Mochi

6. Tarses postérieurs, pris dans leur ensemble, à peine plus longs que leur tibia: Tarses III/Tibia III = 1,1. Aire pygidiale de forme trapézoïdale. 7

—. Tarses postérieurs pris dans leur ensemble, nettement plus longs que leur tibia: Tarses III/Tibia III = 1,5. Aire pygidiale non trapézoïdale. 9

7. Grande taille, longueur 14 mm. Tête et thorax noirs avec quelques dessins rouges, abdomen rouge. Pattes très épineuses.... *sulcipyga* Mochi

—. Taille moyenne ou petite, 7 à 12 mm. Coloration jaune dominante. Pattes peu épineuses 8

8. Bord antérieur du pronotum normal. Clypeus à bord antérieur droit, plus fortement et densément ponctué. Longueur 10-12 mm. .... *lutea* Tasch.

—. Bord antérieur du pronotum denticulé de chaque côté. Clypeus a bord antérieur flexueux, à ponctuation plus fine et plus espacée. Longueur 7-9 mm. .... *pharaonum* Kohl

9. Pas de plaque basilaire au deuxième sternite. 10

—. Une plaque basilaire au deuxième sternite. 14

10. Aire cordiforme portant, sur toute ou presque toute sa surface, de forts sillons bien marqués, disposés en longueur 11

—. Aire cordiforme marquée autrement 12

11. Pétiole étroit, deux fois aussi long que large. Avant-derniers tergite et sternite tous deux anguleux de chaque côté .... *alboatra* Walker

—. Pétiole court, guère plus long que large. Derniers segments de l'abdomen non denticulés .... *rutila* Spin.

12. Longueur 8-9 mm. Ailes hyalines, sauf à la pointe. Abdomen à bandes jaunes, sauf au pétiole et au quatrième segment. ...... (?) *vidua* Klug

—. Espèce de grande taille. Ailes très enfumées. Autrement coloré 13

13. Tête et thorax noirs avec quelques dessins ou points jaunes ou rouges; pétiole noir ou rouge, les autres segments jaunes avec une mince bande noire ou d'un brun foncé au bord terminal...... *erythrocephala* Dhlb.

—. Abdomen tout noir, le pétiole rouge. .... *erythrocephala* var. *gynochroma* Mochi

14. Aire cordiforme allongée, lisse. Pétiole deux fois aussi long que large.. .... *Honorei* Mochi

—. Aire cordiforme de forme normale. Pétiole moins allongé 15

15. Plaque basilaire du deuxième sternite triangulaire, très petite, coloration dominante jaune .... *pallidula* Morice

—. Plaque basilaire du deuxième sternite bien développée............ 16

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—. Hanches antérieures normales 19

17. Prolongement conique des hanches antérieures très développé, égalant presque la moitié du trochanter. Coloration noire et jaune, celle-ci dominant sur l'abdomen .... *Alfierii* var. *picta* Mochi

—. Prolongement conique des hanches antérieures court, égalant le quart de la longueur du trochanter. Noir à bandes abdominales jaunes assez réduites, nulle sur le quatrième segment 18

18. Sixième sternite denticulé de chaque côté. Aire cordiforme lisse et mal délimitée. Face plus haute que large. Pétiole rouge...... *Fischeri* Spin.

—. Sixième sternite non denticulé. Aire cordiforme nettement délimitée sur

les côtés, son sillon médian profond. Face plus large que haute. Pétiole noir .... *subimpressa* Klug

19. Deuxième article du funicule des antennes au moins deux fois plus long que le premier .... *Priesneri* Mochi

—. Deuxième article des antennes pas ou guère plus long que le premier.. 20

20. Aire cordiforme ponctuée au moins sur sa moitié inférieure, terne. Coloration entièrement jaune .... *pruinosa* Morice

—. Aire cordiforme lisse, brillante 21

21. Abdomen jaune. Ponctuation du mésonotum éparse. Aire cordiforme avec un sillon médian .... *pulchella* Klug

—. Abdomen noir ou plus ou moins rouge, à bandes d'un jaune pâle. Ponctuation du mésonotum assez dense. Aire cordiforme sans sillon médian. .... *tricolorata* Spin.

NOTA.—Je n'ai pas compris dans les Tables, le *Cerceris Schmiedeknechti* Kohl, ni l'*albicincta* Schlett. qui ne me sont pas connus en nature.

Dans la Table des femelles, *Cerceris pallidula* se rencontrera deux fois : l'extrême petitesse de la plaque basilaire du deuxième sternite chez cette espèce en rend l'observation pas toujours très nette, aussi ai-je cru bon de la citer dans les deux divisions.

Dans la Table des mâles, j'ai admis *Cerceris vidua* Klug avec un ?. Par contre, j'ai bien dû éliminer, faute de renseignements suffisants, *Cerceris Klugi* Schlett. sensu Mochi.

A study of the biology of the Egyptian common house-fly: *Musca vicina* Macq.

[Diptera : Muscidae]

(with 9 Text-Figures)

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CONTENTS

I. INTRODUCTORY AND HISTORICAL

As the fly problem is now one of the important questions in Egypt for its close relation to the sanitation of the country and improving the hygienic and living conditions of the rural population, its has been found that a study of the biology of the Egyptian common house-fly *Musca vicina* Macq. which — among the class of obnoxious flies — is emphatically the predominant, is quite indispensable to a thorough comprehension of the fly question.

Reviewing the literature, it seems that, neither in Egypt nor in other countries, has an account been given by previous workers on the biology of *Musca vicina* Macq.. Patton (1933) alone has given in a very few lines some remarks on the breeding media of this species. He stated that it breeds in large collections of cow dung, but according to my observations (Hafez, 1939) it does not breed in Egypt in cow dung, but horse and donkey dung afford the chief breeding media of this species.

As regards *Musca domestica* L., the European common house-fly to which *Musca vicina* Macq. is related, a considerable amount of literature on the biology has been given by previous workers such as Gleichen (1790), Packard (1874), Newstead (1907), Howard (1911), Graham-Smith (1913), Hewitt (1914), Roubaud (1915), Austen (1928), Patton (1931), Thomsen (1934 and 1936). But with the exception of Thomsen, most of these workers have inadequately dealt with several points of paramount importance such as the power of attraction of different kinds of dung for ovipositing flies, the influence of temperature and humidity on the duration of larval stages and development, etc.

These points have been taken into consideration as regards *Musca vicina* Macq. by the present author.

II. MATERIAL AND TECHNIQUE

The dung of horse, cow, buffalo, pig, sheep, calf, and goat as well as human excrement was brought fresh from some farms, stables and middens, and distributed in special wooden frames and left exposed in the open for the ovipositing flies. The dung, after about six hours exposure, was taken to the laboratory and when development was completed the adult flies were collected and utilised for the various experiments. This procedure also helped in testing the power of attraction of these different kinds of dung for the ovipositing flies. In following the life-history and in estimating the rate of development, experimants were carried out in the laboratory. Glass tubes and vessels containing suitable amounts of dung were used. The eggs or sometimes the young larvae were placed in these tubes either at room temperature or in the thermostat and allowed to complete development.

The early stages were described from microscopical preparations. The young larvae were preferably killed by and mounted in Faure's mixture. For mature larvae the clearing produced by this method proved insufficient. Such larvae were transferred from alcohol to warm caustic potash and left there until they were sufficiently clear; they were then washed with water, dehydrated and mounted.

The figures of the larvae and their structure were drawn by the aid of the camera lucida.

III. BIONOMICS AND HABITS

1. Seasonal prevalence and local distribution

Musca vicina Macq. or the Egyptian common house-fly, is generally met with all the year round, but the period in which the fly shows itself in greatest abundance is the early summer (April, May and June) and the autumn (September) when the fly breeds very extensively. The temperature conditions in this period in Egypt are very favourable for breeding and development (28-35° C.). During the summer the temperature becomes sufficiently high to prevent oviposition and the development of the early stages; the temperature may rise to 50° C. or more in the sun, and consequently the flies tend to be less numerous in contrast to European countries in which the summer (July and August) is the season of the prevalence of *Musca domestica* L.

During the winter season in Egypt the flies become of uncommon occurrence and in January they become rare. From March, sometimes earlier, the breeding season begins and the number of flies gradually increases until it reaches its maximum in May and June.

The local distribution is mainly dependant on the presence of favourable breeding media and the access of the fly to them. Such access differs with the different localities. As a rule, the common house-fly is not so widely distributed in Cairo and in the larger provicial towns as in the country. It has been previously pointed out by the auther (Hafez, 1939) that in the region of Cairo and other large towns the horse stables, especially those of private people, play an important part in the production of the flies. The floor of such stables is generally covered with a fairly thick layer of dung which is always kept moist by absorbing the urine of the animal, and in this bedding larvae are found in extreme abundance. The other breeding substances of the house-fly such as the house refuse and other decomposing vegetable matter are much less important since in Cairo and towns better sanitary conditions than in the country are afforded.

In the country the flies are more abundant than in towns because of the wide distribution of dung and other breeding substances. Stables for donkey keeping which are most exclusively owned by private people and consequently not carefully looked after are very numerous in most of the Egyptian villages. These stables are generally not cleaned except occasionally at intervals of weeks or even of months, fresh litter, however is supplied frequently which absorbs the urine and affords a dry and soft bedding for the donkeys. The result is that the floor of the stable is provided with a layer often several inches thick of compact litter mixed with dung and urine only the surface being fairly dry. This thick layer affords a very favourable

breeding medium for the fly and always contains very great numbers of the fly larvae.

There is also another important breeding medium which contributes to a great extent to the wide distribution of the house-fly in the country. This medium is the human excrement which in the Egyptian villages, owing to lack of drainage systems and inadequate sanitary arrangements in the houses of farmers, affords a favourable place for the breeding and the production of flies. In several villages there are no water closets or cesspits of any sort in the houses and huge accumulations of human excrement frequently occur in the open.

Other decomposing vegetable matter, the refuse of houses are not got rid of by the people and in my opinion all these factors, together with the unhygienic conditions under which the rural population lives, have contributed to the wider and more extensive distribution of the common house-fly in the country than in the region of Cairo and towns.

2. Influence of temperature and light on the adult

The adult fly is directly influenced by temperature. At a moderately high temperature (28-35° C.) the fly assumes a pronounced activity, which, in Egypt is generally in the early summer and autumn. In the summer the fly activity is slightly reduced due to the high temperature which may reach over 40° C. in the shade and about 50° C. in the sun. In winter, the flies become quite inactive, but however they are able to withstand comparatively low temperature. As regards *Musca domestica* L., some previous workers carried out several experiments in which they submitted the fly to low temperature. Donhoff (1872) submitted *Musca domestica* L. to a temperature of — 1.5° C. for five hours and they continued to move. When the temperature was lowered to — 3° C. and the duration of exposure was prolonged to eight hours the flies moved their legs. After twelve hours exposure to a temperature first of — 3.7° C. and then — 6.3° C. the flies appeared to be dead, but they recovered when brought to warmth. The flies died completely when they were submitted for three hours to a temperature of —10° C. which was then raised to —6° C. Bachmetjew (1906) was able to submit *Musca domestica* L. to as low a temperature as —10° C. and vitality was retained, and the fly recovered when exposed to normal room temperature.

As regards *Musca vicina* Macq., I have performed a number of experiments and the conclusions arrived at involve that the fly can withstand a temperature which is as low as —7° C. with a maximal duration of exposure of six hours. At a temperature of —11° C. and exposed for three hours the flies die.

As regards the influence of light on the adult fly, it is obvious that the fly is attracted to light where it assumes its activity and lays its eggs. In very dark places usually oviposition does not take place. I have carried out several experiments in which the female flies were kept in a big glass vessel with an amount of pig dung and covered with muslin and then put in a dark room : it was noticed that in all the experiments but two, egg laying did not take place.

I have also carried some experiments to ascertain any colour preference by the flies by using large glass vessels, the walls of which were divided into several areas and these were painted each in a different colour. The conclusions arrived at makes me more inclined to believe that the flies did not display any marked colour preference.

But Galli-Valerio (1910) in his experiments on the question of colour preference showed that *Musca domestica* L. preferred the light colours such as the clear green, rose, clear yellow, clear red, etc.

Hindle (1913) pointed out that his experiments appeared to demonstrate that *Musca domestica* L. did not prefer a special colour.

3. Longevity of the adult

To determine the maximal duration in which *Musca vicina* Macq. can be kept alive in confinement several experiments have been carried out. From the results obtained it was found that the maximal duration differed according to the seasons of the year.

In the spring of 1939 (mainly in March) it was possible to keep 25 out of 34 flies alive in captivity for 46 days.

In the early summer of the same year (May) the maximum length of the life of the fly was 18 days.

During the summer (July, 1939) the flies died after 26 days.

In autumn (September, 1939) the flies were kept alive for 31 days. In October, the flies were able to live for 45 days and in winter, mainly in December, it was possible to keep the flies alive for 56 days. It happened that five flies were able to live in January for 70 days. From the results obtained, it is obvious that the maximum length of the life of the fly in captivity is usually attained in winter, mainly in December and January, while at the end of spring and advent of summer the longevity is brought to a minimum, that is probably due to the higher exertion or extreme activity of the fly during this season. In autumn, the life usually reaches to a moderate length. But it is quite likely that such data do not give an exact information about the real length of the natural life of the fly, since the conditions under which the fly lives in captivity are artificial and unnatural.

Other workers have previously carried out some experiments to deter-

mine the longevity of *Musca domestica* L.. Griffith (1908) was able to keep a male fly alive for sixteen weeks. Jepson (1909) succeeded in keeping alive for eleven and half weeks flies which had been reared in captivity in February. He adds that in the summer he was not able to keep the flies in captivity for more than three weeks. Hewitt (1914) states that he never succeeded in keeping flies alive in captivity for a longer period than seven weeks.

IV. BREEDING HABITS

1. Different breeding media

In 1935, when I started my study on the insect fauna of dung in Egypt, I laid more stress on investigating the different dung breeding media of some common flies especially *Musca vicina* Macq.. Five kinds of dung were chosen for study (cow, buffalo, camel, horse and pig dung). But I had not had the chance of studying other kinds of manure and investigating their importance as breeding media. Therefore, it was found advisable when studying the biology of *Musca vicina* Macq. to take into consideration the dung of calf, sheep and goats which are very widely distributed in Egypt and also to direct much attention to the possible practical importance of human excrement as a breeding medium. I have also borne in mind to take the advantage of this opportunity and confirm my previous observations made in 1937. My observations have been extended to about 146 farms, stables and other places. Only the main results of my observations and experiments will be given here, the details being described in my paper on «Investigations into the Problem of Fly Control in Egypt», which is published in this Bulletin, pages 99-144.

1. Horse manure

Observations on farms and stables in the region of Cairo and in towns as well as laboratory experiments have shown and definitely proved that horse manure under natural conditions is the most important breeding medium for *Musca vicina* Macq. and to a very great extent responsible for the fly production in Cairo and in towns. Most of the stables especially those owned by private people are not cleaned except occasionally at intervals of weeks or even of months. Fresh litter, however, is supplied frequently which absorbs the urine and affords a dry and soft bedding to the horses. The result is that the floor of the stable is provided with a layer about one foot thick, and of compact litter mixed with dung and wet with urine and only the surface being fairly dry. In this thick layer eggs and larvae of *Musca vicina* Macq. are found in extreme abundance. The temperature in this layer may account for that since it varies from 30-35° C. which is very suitable and

attractive to the egg-laying females. Also heaps of horse dung mainly those intended to be utilised as manure frequently occur in the open. Under conditions prevailing in Egypt such heaps afford a very suitable breeding medium for *Musca vicina* Macq.

The female fly may sometimes lay eggs on small masses of horse manure deposited in the fields, and hatch into larvae, but generally in this case horse manure is an unfavourable breeding medium since it soon dries up and any larvae present may perish. Also the fly will not oviposit in single horse droppings scattered in fields and on roads. Evidently they dry up too rapidly and are in addition broken up by birds.

2. Pig dung

Musca vicina Macq. breeds in pig dung. If the pregnant flies are free to choose they will concentrate on the pig dung which seem to have a greater attractive power for the ovipositing females than horse manure and also proved to be a more favourable breeding medium since it can retain its original texture, humidity, peculiar odour, etc., longer than horse manure partly at least owing to the fact that fermentation takes place more slowly. Generally, the pig sties are not carefully looked after and kept clean. The droppings of the pigs are allowed to stay a long time without being removed, and thus induce the oviposition of females and the favourable temperature of the dung also contributes to that.

3. Cow and Buffalo dung

Repeated investigations have confirmed the results previously obtained by the present author in 1937 (Hafez, 1939) that under Egyptian rural conditions *Musca vicina* Macq. will only exceptionally oviposit in pure cow or buffalo dung. That is probably due to some internal factors in the flies, also the temperature and the chemical and biological composition of dung, etc., may have something to do with the repugnance of the flies towards these kinds of dung.

4. Sheep and Goat dung

Owing to the wide distribution and extreme abundance of sheep and goats in the country in Egypt, there are special stables fitted exclusively for their keeping at night. My visits to these houses have clearly shown that sheep and goat dung, which is generally mixed with straw and litter, is a favourable breeding medium for *Musca vicina* Macq.. Prodigious numbers of larvae are met with in the layers of dung usually accumulated on the floor of these houses. Also the suitable temperature, humidity and food con-

ditions in these places contribute to the acceleration of the developmental period of the fly and favours the breeding activity.

5. Calf dung

This sort of dung seems to be of no importance as a breeding medium for the Egyptian common house-fly. Laboratory experiments have shown that it usually does not attract the flies for oviposition, thus resembling cow and buffalo dung.

6. Fowl dung

The common house-fly breeds in this kind of dung, although its attractive power for the ovipositing females is incomparable to that of other sorts of manure. Under natural condition this dung as a breeding medium is of no considerable importance since the droppings are usually of small size and dry up very rapidly. Only in cases where there is a very large number of fowls kept in the house of the farmer, it is found that the accumulated dung together with the decomposing vegetable matter, etc., may be a favourable breeding medium for the fly.

7. Human excrement

Thorough investigations near towns and in a large number of the Egyptian villages revealed the fact that human excrement is a very important breeding medium for the common house-fly and is to a great extent responsible for the fly production in several localities. In nearly all the villages, the drainage systems commonly found in towns are not available, and quite a large number of houses are not provided with water-closets of any kind and consequently the people make use of certain pans or vessels and when these are filled up, then they are emptied onto a heap of excrement outside or near the village. When these droppings were examined, it was found that they harbour very large numbers of larvae of *Musca vicina* Macq., the adult flies being also seen in swarms hovering about the excrement and depositing their eggs on it. Single droppings usually met with in villages seem not to attract the ovipositing females. In one of the experiments the adult flies emerged in moderate abundance from human excrement after a period of development of about thirteen days which is an exceptionally long period of development probably owing to unfavourable conditions in regard to humidity and food.

8. House refuse

Usually, the fly breeds in this substance but not in abundance due to the possibility of being dried up very rapidly. Only when this refuse with decomposing vegetable and animal matter are collected and piled up in large heaps or public dumps the flies are attracted for oviposition in large numbers, and the larval development may be accelerated by the internal temperature, and favourable food conditions.

2. Breeding season

According to observations and experiments it was found that wherever food conditions and humidity are available, and a favourable temperature is present, the breeding activity becomes pronounced and the flies will lay their eggs, and the larvae will develop at any time of the year. But under natural conditions, the temperature differs with different months of the year. In Egypt, the most favourable temperature for fly breeding is in the early summer (April, May and June) and in the autumn (September) in which the flies assume a very pronounced activity in egg-laying and show themselves in very large numbers. In spring (February and March), flies occur in moderate abundance and the breeding activity is not pronounced. In summer (July and August), the temperature is sufficiently high (40-50° C.) to render oviposition and development not abundant. During the winter months (December and January), the breeding activity in the open is markedly diminished because of the low temperature. But in stables, pig sties, etc., the temperature may remain sufficiently favourable and allow the oviposition and the development of larvae to go on.

V. LIFE-HISTORY

1. Sex-ratio

Extensive observations in different localities of Egypt showed that in farms and stables, where accumulations of dung and decomposing matter afford a very suitable breeding medium, there is always a remarkable preponderance of females, and that mostly occurs in the early summer and autumn (September) when breeding activity attains its climax. It happened twice in a pig sty and a horse stable that the proportion of females to males present was 16:1. In the very early spring (February), generally the number of females is slightly less than that of the males. In and around houses, especially in towns, the ratio of sexes is nearly equal, sometimes the females sligthly exceed the males in number. As regards *Musca domestica* L., Hammer (1909) found that in the early summer the males were slightly in the

majority. Herms (1911) mentioned that near the breeding places the females exceed the males in number. Hewitt (1914) stated that the number of the females is approximately equal to that of the males.

2. Sexual maturity

To find out the length of the period extending from the time when the fly emerges from the pupal case until it becomes sexually mature and able to lay eggs, several experiments have been carried out it the laboratory. In one of the experments (April, 15th 1939) 26 third stage larvae of *Musca vicina* Macq. were placed in a glass vessel with a suitable amount of pig dung and covered with muslin. The larvae were left to pupate and in about three days the adult flies emerged. These were transferred to another glass vessel with fresh pig dung. The dung was changed every two days. It was noticed that the flies became sexually mature and some females were seen to copulate with the males after about five days at room temperature (25-30° C.). Some of these impregnated females started laying eggs two days after copulation, some others three days. In other experiments carried out in May 1939, at 31° C., the flies became sexually mature and then copulated in about three days and started oviposition two days after, sometimes the whole period was prolonged and the flies began to lay eggs in nine days after their emergence from the puparium. But it should be pointed out that under natural conditions and at the very favourable temperature in Egypt, especially in the early summer (30-37° C.), the duration of sexual maturity is very likely to be considerably shorter than that found out in the experiments. As regards *Musca domestica* L., Hewitt (1914) stated that the flies became sexually mature in ten to fourteen days after their emergence from the pupal case and four days after copulation they began to deposit their eggs. Such a long period of development has never been recorded in my experiments with *Musca vicina* Macq.

3. Oviposition

Oviposition frequently occurs during the hot period of the year, and reaches its maximum in the breeding season which is here the early summer (April and May) and autumn (September) when the flies are seen in extreme abundance settling on the various kinds of dung and other breeding media. The eggs are laid by the females shortly after copulation. They are deposited on different food and breeding substances of which horse manure and pig dung, if the latter is in access, are the most preferable media for the ovipositing flies. When the female settles on the dung, it slightly bores its way in its substance, and in a small concealed crevice away from the light it

deposits its eggs by extending its ovipositor. When the process of egg-laying is finished, the eggs are generally covered by dung and thus protected from becoming dry. In some cases, especially in horse and donkey stables and in pig sties where no strong light occurs, the eggs are deposited on the surface of dung especially at the corners and near the side walls of the stable. The eggs are laid in masses or clusters and usually are closely grouped together.

4. Duration of the egg-stage

According to my experiments, in which several eggs of *Musca vicina* Macq. were allowed to hatch at different temperatures, it was found that the duration of the egg-stage differed widely as shown from the measurements and readings given in Table I.

TABLE I

TEMPERATURE IN °C.	DURATION OF EGG-STAGE IN HOURS
35-38 (mainly 36)	6
30-35 (mainly 32)	8
25-30 (mainly 28)	11
20-25 (mainly 22)	18
15-20 (mainly 17)	30
10-15 (mainly 12)	40

5. Larval moults and duration of the larval stages

The egg hatches into the first stage larva in about 11 hours at room temperature (25-30° C.). This larva is a very small creature crawling very sluggishly in the substance of the dung and feeding on it. It grows in size rapidly and in about 15 hours after hatching at a temperature of 30-33° C. it undergoes ecdysis. When the temperature was lowered to 25° C. the duration of the first larval stage was about 20 hours. In Egypt, where the temperature and food conditions are very favourable usually, the duration does not exceed 20 hours, in several cases, especially in summer, it is always about 15 hours and sometimes less. Moulting begins in the anterior region of the larva which gradually gets rid of its old skin together with the anterior cephalo-pharyngeal skeleton.

The first larval stage is followed by the second larval stage in which the larva is distinctly bigger and slightly more active, and in about 20 hours. at a temperature of about 30° C., it undergoes ecdysis and leads to the third stage larva. It happened in one of the experiments that the duration of the

second larval instar was as short as 16 hours at a temperature of 31° C. With lower temperature (20-25° C.), it was prolonged to about 30 hours.

In the third or last larval stage, the larva grows very rapidly and attains a much larger size than in the previous stages. It is more active and crawls about in the different parts of the dung, escaping always the strong light, and is seen always in large numbers at the deepest layers of the dung mass, sometimes (especially in summer) on the surface of the soil just below the dung where more humidity and lower temperature are available. Very rarely the larvae occurred near the surface layers, that was apparently due to the very high summer temperature in Egypt (about 40° C. in the shade and 50° C. in the sun). At a temperature of about 30° C., this larval stage lasted about two days, and when the temperature was lowered to 25° C. it was prolonged to about three days after which the larva pupated. To sum up the total duration of the larval stage it can be said that at a temperature of about 30° C. the three larval stages last about three days and a half, and such duration may be liable to a further shortening with more favourable food conditions and a slightly higher temperature.

6. Pupal stage

Usually, when the larva approaches pupation it turns creamy-white in colour, stops feeding and becomes very sluggish in movement and finally contracts, the anterior end being drawn in with the consequence that a more or less cylindrical puparium is formed. It should be pointed out that in the majority of dung masses examined the larvae (prior to pupation), always leave the surface and middle layer of the dung and escape to the deepest regions near the soil, and in many cases they tunnel in the dung until they reach the surface of the soil just below the dung where they pupate. At a temperature of about 30° C., the pupal stage lasts about three days. At 26° C. it was prolonged to four days after which the adult fly emerged.

7. Summary of duration of development

According to my results obtained under experimental conditions it was found that the shortest period for the duration of the whole life-cycle of *Musca vicina* Macq. is six days seventeen hours distributed as follows :

Egg stage	six hours.
First larval stage	fifteen hours.
Second larval stage	twenty hours.
Third larval stage	two days.
Pupal stage	three days.

These short durations were taken at a temperature of about 30° C., sometimes slightly higher, but it is very likely that under natural conditions the development is accomplished in less than six days seventeen hours since the internal temperature and the food conditions in the breeding media are more favourable. Under unfavourable food conditions and at a lower temperature, about (25° C.), the total duration of the life-cycle may be prolonged to nine days or more. But generally such long duration which is obtained under pure experimental conditions does not frequently occur in nature in Egypt. As regards the minimum duration of the whole life-cycle of *Musca domestica* L., Howard (1895) stated that according to his observations at Washington it was ten days. Newstead (1907) in his osbervations in Liverpool obtained a minimum duration of ten to fourteen days from the deposition of the egg to the emergence of the adult. Smith (1907) in India gives the rate of development in horse manure as eight days. Griffith (1908) in his experiments in South England recorded the duration as eight days. Hewitt (1914) stated that the minimum period of life history is eight days four hours. Thomsen (1934) in Denmark recorded seven days four hours, at 33° C.

8. Factors affecting development

Temperature, humidity and the nature of the larval food, etc., are undoubtedly very important factors which highly influence the rate development. Under experimental conditions at a temperature of about 30° C., it was shown that the duration of the whole life-cycle is six days seventeen hours, and when the temperature was lowered to 25° C. the duration was prolonged to about nine days. In some experiments which have been carried out in the open and in which pig dung was utilised as a breeding medium, it was found that development was completed in about ten days at an average, though not constant, daily temperature of 24° C.

In order to determine the influence of temperature on the development of the different stages of the life-history, a systematic investigation in thermostats has been carried out believing that this would be the one method likely to give precise data, since the internal temperature of the breeding media, e.g., manure heaps is subject to considerable variations. The results of my investigations which are carried out with pig dung are given in Table II.

It is now obvious from these data that wherever a continuous high temperature occurred there was a corresponding shortening in the different stages of the life-history. The shortest duration of development obtained is five days six hours at 38° C., and when the temperature was lowered the duration of all the stages was lengthened, the longest developmental period recorded is nineteen days eight hours at 13° C. In a few experiments, temperature as

high as 40° C. was used; but it was noticed that it has a very detrimental effect and a heavy mortality of larvae was recorded.

TABLE II

TEMPERATURE IN °C.	DURATION OF EGG-STAGE	DURATION OF FIRST LARVAL STAGE	DURATION OF SECOND LARVAL STAGE	DURATION OF THIRD LARVAL STAGE	DURATION OF PUPAL STAGE	TOTAL DURATION	
	hours	hours	hours	hours	hours	days	hours
38	5	12 - 15	16	34	59	5	6
36	6	13	18	36	62	5	15
34	7	14	20	41	66	6	5
31	8	15	22	46	72	6	19
27	11	18	26	58	83	8	4
25	13	22	31	70	94	9	14
21	18	28	37	86	111	11	16
18	26	39	49	93	127	13	22
15	37	53	60	106	142	16	14
13	42	60	75	120	167	19	8

A second very important factor affecting development and one closely connected with temperature as well as the other factors, such as humidity and the nature of the breeding medium, is that of fermentation. During the process of fermentation, heat is generated inside the manure heaps. This heat differs with different breeding media. In some of these, the temperature may be favourable and accelerate the rate of development, and in some others, which may be the majority, the temperature is sufficiently high to cause death to any of the early stages of the fly. To test the importance of fermentation to development, several observations have been made on large heaps of horse dung, pig dung, cow dung, donkey dung, human excrement and other decomposing substances, and it has been found that only in cow dung, human excrement and in some decomposing vegetable matter the heat generated was favourable enough (about 30-35° C.) to accelerate the rate of development. But with the other kinds of dung, the case was different. In horse dung the temperature was about 75° C. which is undoubtedly absolutely fatal to flies at any stage of development. In pig dung the temperature recorded was about 68° C. which is also detrimental. Fermenting donkey dung accumulated in stables also generated heat which is strong enough to render the survival of the early stages of the fly impossible. It was generally

found that the fly-breeding capacity of the manure is reduced with progress of fermentation, especially in cow, horse and donkey dung. In pig dung, however, the fly breeding capacity is retained much longer than in other kinds of dung.

A third important factor that has a remarkable influence on development is humidity which also differs according to the breeding media. In a previous paper by the author (Hafez, 1939), it was shown by experiments that horse dung, owing to its loose and coarse nature on one hand and very high temperature in Egypt during the summer of the other hand, dries up quite rapidly and in a few days loses most of its water content. In cow dung and pig dung the drying up takes place more slowly due to the high water content in the dung from the beginning and the considerably thick crust formed on the surface of the dung. Under natural conditions the case may be somewhat different since these different kinds of dung are accumulated in large heaps and thus drying is very slow and favourable humidity is available. In the laboratory several experiments were carried through with the purpose of determining the possible influence of humidity on the rate of development. In two series of experiments carried out, horse dung was utilised as a breeding medium and the temperature was 25-30° C. In the first series the dung was kept moist by adding few drops of water or urine whenever it showed any signs of becoming dry, while in the second series the dung was left to dry up. It was noticed that the larvae reared in the first series completed development in ten days while those of the second series in nineteen days.

Therefore, it is obvious that under similar conditions with regard to temperature the rate of development is proportional to the condition of the breeding medium and food as regards moisture. In some of the experiments it was also noticed that with insufficient moisture the flies emerged were undersized. Considerable lack of humidity proved to be of a very detrimental effect on the larvae.

A fourth factor that undoubtedly plays an important part on the development is the nature of the breeding medium or in other words the character of the larval food. Different kinds of dung or other media differ from each other in several respects such as the chemical and biological composition and that, accordingly, may differently influence the rate of development. Therefore, a series of experiments were carried out to determine the different rates of development with different kinds of food. In one of the experiments, horse dung, pig dung, donkey dung, sheep dung, human excrement and kitchen refuse were utilised, each being placed in a glass vessel with a number of very young larvae. The average temperature was about 27° C., and moisture was rendered available. It was found that the durations of

development were about eight days in pig and horse manures, about ten days in sheep dung, fourteen days in human excrement, and about twenty days in the kitchen refuse. That obviously shows that although these larvae were bred under the same conditions of temperature and nearly same moisture yet they completed development in different durations indicating that they are influenced in different degrees by different breeding media and food conditions.

VI. MORPHOLOGY OF THE EARLY STAGES

1. Egg and hatching mechanism

The egg of *Musca vicina* Macq. (Fig. 1.) is 0.9 to 1.1 millimetre long. The colour is shining white. The shape is nearly oval-cylindrical with a slightly tapering anterior end. The posterior end is somewhat rounded and distinctly broader. The surface of the egg-shell is finely sculptured with minute and very faint hexagonal areas or markings. These are less distinct than those of *Musca domestica* L.. A ventral and dorsal sides corresponding to

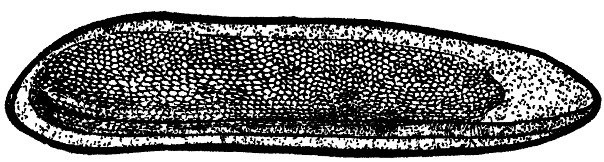


Fig. 1. — Egg of *Musca vicina* Macq. — × 80.

those of the larva can be distinguished; the ventral side is convex, the dorsal is somewhat concave with a broad but not pronounced and nearly spindle-shaped area bordered by a continuous groove. During the process of hatching the egg-shell splits along the border line of the spindle-shape area at one side only. This begins always at the anterior end and then continues posteriorly, and by this time the first stage larva crawls out.

2. The first stage larva

The larva of *Musca vicina* Macq. just after hatching is as long as the egg (1.1 mm.), but during the first instar a remarkable increase in size and length of the larva takes place as shown by the following measurements :

Length in millimetres : 1.3, 1.5, 2.0, 2.4, 3.0, 3.6.

The shape of the anterior four segments is nearly conical, while that of the rest of the abdomen is cylindrical with the last segment obliquely truncate. The tegument of the living larva is thin and transparent so that

the internal structures such as trachea, alimentary canal and other organs can be easily seen through the skin.

The body segments are apparently twelve in number; a small conical head, followed by three thoracic and eight abdominal segments.

On the ventral surface of each of the eight abdominal segments there is a transverse band of spines situated along the anterior margin of each segment. The spines of the same spiniferous band are of varying size.

There are no anterior spiracles in the first larval stage. Respiration is of the metapneustic type. The spiracles are simple in structure. Each of the longitudinal tracheal trunks dilates posteriorly and opens in the last abdominal segment by a pair of small oblique slit-like apertures situated on a small prominence.

The head is divided into two anterior lobes. There is a small two-segmented antenna or sensory papillae on the dorsal side of each lobe. The distal segment is more slender and partly inserted in a thicker and shorter proximal one. Anterior to the antenna there is another sensory organ, the so-called maxillary palp consisting of about 8 minute tube-like structures lying close to each other.

The area behind the lobes is covered dorsally with minute tubercles. In the ventral surface around the mouth there is an incomplete and nearly circular area traversed by radially arranged grooves or furrows some of which, especially those situated more anteriorly and posteriorly, are slightly shorter than the others. These furrows correspond to the food channels found in other Muscoidean larvae, and serve to distribute the saliva over the surface of the food substances.

The cephalo-pharyngeal skeleton of the first stage larva differs considerably from that of the other stages. Generally, it is much slender and less chitinized. Posteriorly, there is a pair of large pharyngeal sclerites deeply incised behind forming dorsal and ventral cornua or prolongations, the dorsal being shorter and more weakly chitinized. The ventral floor of the pharynx is unchitinized and transparent. The two pharyngeal sclerites are connected dorsally and anteriorly by a small chitinized dorsal arch. The front ventral edges of the pharyngeal sclerites are connected with the anterior sclerites of which the one next to the pharyngeal sclerites is the hypostomal sclerite. This consists of an unpaired median plate. Dorsal, but more anterior to the hypostomal sclerite, there is a rather large median plate which may be called the epistomal sclerite. This is markedly curved from side to side and strongly chitinized at its latero-ventral edges. It is also provided with an anterior and posterior pairs of sensory organs.

Anterior to these sclerites there is the mouth-hook, or the mandibular sclerite, with its tip curved downwards. It is slender and heavily chitinized.

Lying on either side of the mouth-hook there is a small curved plate known as ectostomal sclerite (Thomsen, 1935). Between the ectostomal sclerites, dorsally, is an unpaired rod-shaped sclerite which may be termed according to Lowne (1890-1892) the prestomal sclerite.

3. The second stage larva

The length of the second stage larva of *Musca vicina* Macq. varies between 4.0 and 7.8 millimetres. In general shape this larval stage resembles the first, but however there are some points of difference in detail. The spiniferous bands or locomotory pads are well developed. Respiration is of the amphipneustic type. The prothoracic or anterior spiracles are provided with 5 to 8 finger-like processes. In *Musca domestica* L., according to Hewitt (1914), there are seven of these digitate processes. Each of the posterior spiracles opens by two small orifices similar in shape to those of the first instar but distinctly larger in size. The head of this stage is morphologically very similar to that of the third stage, which will be described later.

Cephalo-pharyngeal skeleton : The pharyngeal sclerites are much like those of the third stage. The hind part of the ventral prolongations are not chitinized. The dorsal arch is now a distinct sclerite provided with irregular perforations or holes giving it a reticular appearance.

The hypostomal sclerite is separate from the pharyngeal sclerites, but still articulates with their ventral cornua. It is now composed of two distinct strongly chitinized plates connected transversely by a narrow bar of chitin and thus giving the H-shape.

In front of the hypostomal sclerite there is the epistomal sclerite which is now saddle-shaped and heavily chitinized and also provided with the two pairs of sense-organs which are here more distinct than in the previous stage. Anterior to the epistomal sclerite on each side, there is a small short curved plate named by Thomsen (1935) the accessory stomal sclerite.

In front of these are the paired mandibular sclerites or mouth-hooks which are more chitinized and with slender anterior and thick posterior ends. On either side of the mouth-hook there is the ectostomal sclerite which is here well developed and roughly triangularly shaped.

4. The third stage larva

The third stage larva varies from 8.0 to 13.2 mms in length, sometimes reaching 14 mms. The larva increases remarkably in size during this stage. The head of the full-grown larva (Figs. 2 and 3) displays some important features. It has the mouth situated ventrally in a slight depression. From this oral depression numerous fine furrows of a chitinous nature radiate

and occupy most of the ventral surface of the head. These furrows serve as food-channels in which the food passes to the mouth. The head or cephalic lobes are here very distinct and well pronounced and each is provided with the usual small two-segmented antenna and the so-called maxillary palp made of about 8 sensillae.

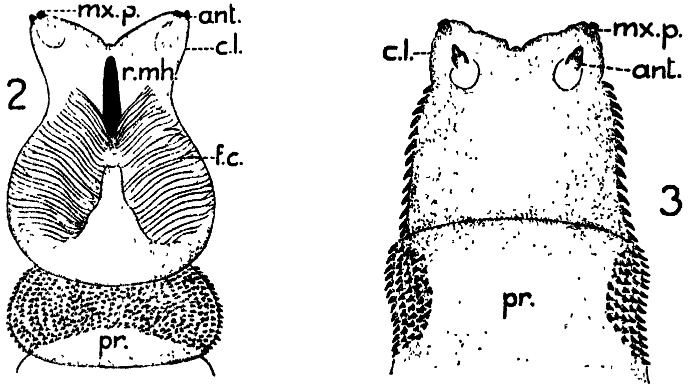


Fig. 2. — Ventral view of head and prothorax of third stage larva : *ant.*, antenna; *c.l*, cephalic lobe; *f.c.*, food channel; *mx.p.*, maxillary palp; *pr.*, prothorax. — × 170.

Fig. 3. — Dorsal view of head and prothorax of third stage larva : *ant.*, antenna; *c.l.*, cephalic lobe; *mx.p.*, maxillary palp; *pr*, prothorax. — × 15.5.

The anterior portion of the prothoracic segment is distinctly demarcated from the head and from the rest of the segment so as to form a sort of collar into which the head can be retracted. It is covered with small spines. The

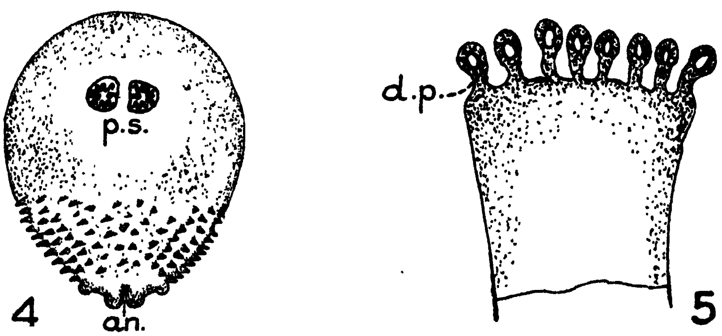


Fig. 4. — Last abdominal segment of third stage larva (back view) : *an.*, anus; *p.s.*, posterior spiracle. — × 46.

Fig. 5. — Anterior spiracle of third stage larva : *d.p.*, digitate process. — Much enlarged.

eight abdominal segments show a remarkable increase in size towards posterior end. The transverse bands of spines on the ventral surface of each segment are here more conspicuous and the spines are more developed. These bands are considered to be locomotory pads by means of which the larva moves forwards and backwards. The last segment (Fig. 4) is richly provided with papillae and thick spines which help in locomotion together with two prominent anal lobes situated ventrally. This segment also bears the anus which is a longitudinal slit.

The prothoracic spiracles (Fig. 5) have five to eight digitate processes. The posterior spiracles (Fig. 6) are very well developed and show a more complicated nature. They are D-shape with the angles rounded and the flat

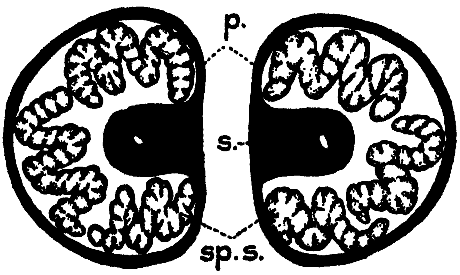


Fig. 6. — Posterior spiracle of third stage larva : *p.*, peritreme; *s.*, scar; *sp.s* , spiracular slit. — × 315.

faces opposing each other. Each spiracle consists of a chitinous ring (peritreme) enclosing three sinuous slits of a characteristic shape, each slit having a row of somewhat irregular denticles along its border forming a sort of a filter. The three slits communicate with the spiracular atrium situated behind the spiracle. Inside the chitinous ring and internal to the flat side there is the scar (cicatrix).

The cephalo-pharyngeal skeleton (Figs. 7 and 8) is composed of several sclerites of which the most anterior are the two mouth-hooks or mandibular sclerites which form the most prominent part of the mouth skeleton. It should be here pointed out that treating with warm caustic poptash (5%) proved very successful in bleaching and clearly demonstrating the mouth-hooks, but when unbleached preparations are examined from the side view the right hook may hide the left one, so that the real condition is not seen and probably is due to such inadequate technique that other previous workers such as Bank (1912) and Hewitt (1914) stated that there was only one unpaired mandibular sclerite or mouth-hook. The two hooks are not equal or identical,. the left being smaller and shorter than the right. The anterior part of the left sclerite is distinctly more slender and pointed than

that of the right sclerite. The posterior parts of the two hooks are nearly similar in shape and size. The holes or light spots regarded as sense organ on the internal side of ach mouth-hook is much less distinct than in case of *Musca domestica* L.. The hooks are curved downwards and the right hook

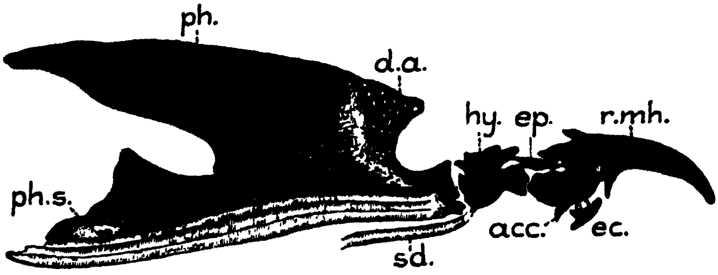


Fig. 7. — Lateral view of the cephalo-pharyngeal skeleton of the third stage larva : *acc.*, accessory sclerite; *d.a.*, dorsal arch; *ec.*, ectostomal sclerite; *ep.*, epistomal sclerite; *hy.*, hypostomal sclerite; *ph.*, pharyngeal sclerite; *ph.s.*, pharyngeal sense organ; *r.mh.*, right mouth hook; *sd.*, salivary duct. — × 120.

is provided with a depression on its ventro-median side. There is, however, some amount of variation in the size and degree of curvature of the two hooks, sometimes the left hook is almost straight.

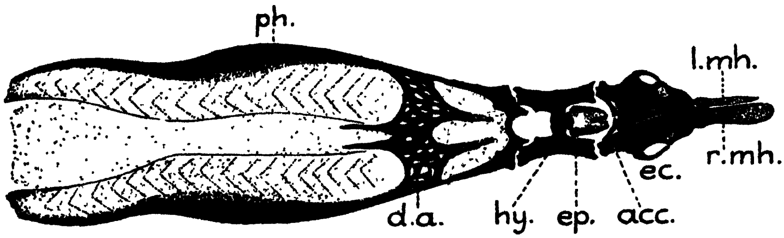


Fig. 8. — Dorsal view of the cephalo-pharyngeal skeleton of the third stage larva : *acc.*, accessory sclerite; *d.a.*, dorsal arch; *ec.*, ectostomal sclerite; *ep.*, epistomal sclerite; *hy.*, hypostomal sclerite; *l.mh.*, left mouth hook; *ph.*, pharyngeal sclerite; *r.mh.*, right mouth hook. — × 125.

Like *Musca domestica* L., there is in between the two mouth-hooks an unpaired median sclerite the presence of which is a remarkable feature described for the first time by Thomsen (1935).

This sclerite consists of a slender anterior part distinctly shorter than the mouth-hooks and a broader posterior part which in some cases seems to be attached or touching the inner sides of the hooks.

Associated with the two mouth-hooks are two pairs of small sclerites,

the largest of which or the ectostomal sclerites of Thomsen (1935) or dentate sclerites of Hewitt (1914) form two curved structures each of which lies on the ventral and lateral side of the corresponding hook. Each ectostomal sclerite begins dorsal with a slender part, curves on the sides and becomes ventral with a slightly broader part below the hook. The other pair of sclerites — the accessary sclerites — is smaller than the ectostomal sclerites and is situated ventral to and near the posterior portions of the mouth-hooks. Each accessory sclerite is a slender rod and indistinctly forked at the median end.

Posterior to the mouth-hooks and more distinctly seen from the dorsal view is a single epistomal sclerite which is somewhat smaller in size and more slender than that of *Musca domestica* L.. It is elongate and curved from side to side. For the most part the sclerite is weakly chitinized, only the sides which bend ventrally and end in a serrated edge are strongly chitinized. The sclerite is provided dorsally with two pairs of sense-organs, an anterior and an posterior pair. The anterior sense organs lies nearly at the tip of the sclerite and appears as light spots of simpler nature. The posterior pair is more distinct and in the form of two dark areas enclosed in light rings. They are situated at a short distance from the posterior extremity of the sclerite.

Behind these sclerites there are the hypostomal sclerites. They consist of two irregularly shaped lateral portions united by a ventral bar of chitin. Each sclerite is longer than broad with its body produced into small angular processes. Below these sclerites posteriorly the two salivary ducts unite.

Next to the hypostomal sclerites there are the two large pharyngeal sclerites. They are narrower anteriorly and broader posteriorly, where they are deeply incised thus producing dorsal and ventral cornua or prolongations. The dorsal cornua are more slender with a convex upper edge, the ventral cornua are broader with a nearly straight lower edge, but the upper margin or edge of each of the ventral cornua is produced into a somewhat angular process which is a very conspicuous character. The whole body of the sclerite except the lower edge is very strongly chitinized and is nearly black in colour.

The pharyngeal sclerites are connected anteriorly by a perforated dorsal plate — the dorsal arch — which can be easily seen in bleached preparations, otherwise it looks as uniform black structure. It may be stated that the light spots are not real perforations but closed by a thin transparant chitinous membrane (Thomsen, 1935).

Ventrally, the pharyngeal sclerites are continuous with the floor of the pharynx, and at the posterior end of the ventral cornua there are the pharyngeal sense organs which are more distinct in unbleached preparations.

5. The puparium

The puparium (Fig. 9), or pupal case, is nearly cylindrical in shape with a slightly tapering anterior end and a distinctly broader and rounded posterior end. It varies in length from 6.0 to 8.2 mms., but the average length is about 7.0 mms. In *Musca domestica* L., according to Hewitt,

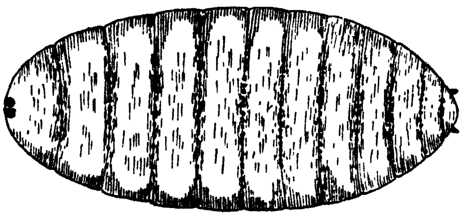


Fig. 9. — Puparium of *Musca vicina* Macq. — × 9.

it is 6.3 mms. The colour immediately after pupation is pale yellow and gradually darkens and finally becomes dark reddish-brown. The pupal spiracles or the anterior spiracles of the larva now appear as minute processes situated anteriorly. The posterior spiracles form two flat button-like structures on the posterior end.

The borders between the segments appear as dotted lines which are very distinct along the middle region of the puparium. The surface of the cuticle is marked with incomplete delicate transverse wrinklings or striations.

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Contribution à la connaissance des espèces égyptiennes du genre *Palarus* Latr.

[Hymenoptera : Sphegidae]

par le Dr. A. Honoré

Faire revivre, dans le cadre de la Faune Egyptienne, un genre dont les espèces étaient, pour la plupart, reléguées dans le fâcheux no mans' land des « species ignotae vel minus cognitae », voilà le but que je me suis proposé en écrivant les lignes qui vont suivre.

F. F. Kohl avait publié, en 1884, son mémoire « *Die Gattugen und Arten des Larriden Aut.* ». Sous sa modeste apparence, ce travail totalisait un ensemble de recherches et d'études considérable ; quelques genres tels que *Miscophus*, *Tachytes* et *Tachysphex* y sont traités avec une rare maîtrise, d'autres, et parmi ceux-ci le genre *Palarus*, sont d'une indigence manifeste.

L'auteur n'en est réellement pas responsable : la faute en est bien plutôt aux lacunes que devaient présenter les collections dont il disposait. Elles devaient être bien pauvres, ces collections, en ce qui concernait la faune d'Egypte ! Quand on songe que Kohl, dans ce même travail, dit ne pas avoir eu sous les yeux le mâle de *Liris haemorrhoidalis* Fab. ; il ne l'a connu que bien plus tard par l'examen des chasses en Egypte du Rév. F. D. Morice. Ce dernier s'extasie, en 1900 (1), sur ce qu'il a pris en deux jours, entre le Marg et le Caire, plus de *Nectanebus Fischeri* Spin. et de *Masaris vespiformis* Fab., qu'il n'y en avait à cette époque dans tous les grands Musées d'Europe réunis !

Au cours de chasses plus ou moins assidues aux environs du Caire, chasses se répartissant sur une quinzaine d'années, et allant du premier printemps au début de l'été, j'ai pu rassembler assez de matériaux pour me per-

(1) F.D. Morice (*The Entomologist's Monthly Magazine*, 1900, p. 164).

mettre d'identifier les espèces décrites par Spinola, Klug et autres, avec, le cas échéant, les deux sexes appariés sans hésitation possible.

Genre PALARUS Latr., 1802

Caractères du genre :

Mandibules échancrées à leur bord inférieur. Yeux gros, entiers, atteignant en dessous la base des mandibules, plus ou moins convergents vers le haut de la tête ; ocelle antérieur globuleux ; ocelles postérieurs, dans les espèces d'Egypte, aplatis, allongés.

Ailes antérieures : cellule radiale largement tronquée, avec l'indication d'une cellule appendiculaire ; trois cellules cubitales, la deuxième d'allure triangulaire, presque pétiolée, la troisième plus large sur son bord radial que sur son bord cubital.

Ailes postérieures : nervure cubitale sortant de la nervure médiane en dehors de la cellule sous-médiane qui est très allongée.

Segment médiaire court, abrupt, sa face supérieure fortement sillonée en travers, creusée d'une gouttière médiane et de deux sillons latéraux plus ou moins marqués.

Premier segment abdominal (apparent) creusé sur sa face antérieure, et plus ou moins fortement caréné sur les côtés ; à partir du troisième segment, les tergites sont plus développés que les sternites, leur jonction se faisant nettement sur la face ventrale, sous forme de bourrelets carénés. Le deuxième sternite porte généralement une carène transversale épaisse, saillante et de formes diverses. Tous ces caractères s'atténuent plus ou moins chez les petites espèces, et s'effacent complètement chez *Palarus eximius* nov. spec.

Aire pygidiale présente chez les deux sexes ; chez les femelles, en forme de triangle étroit, très allongé ; chez les mâles, de forme très variable suivant les espèces, généralement fourchue ou tri-épineuse.

Pattes robustes, fortement épineuses ; peigne tarsal présent dans les deux sexes, aux pattes antérieures. Hanches intermédiaires assez largement séparées ; les tibias intermédiaires n'ont qu'un seul éperon.

Distinction des sexes. — En dehors du nombre d'articles des antennes (♂ 13, ♀ 12 articles), les mâles à antennes longues ont les articles intermédiaires dilatés. Ce qui, dans nos espèces, permet de distinguer les mâles à première vue, c'est la forme de l'aire pygidiale (dernier tergite visible), qui peut être fourchue, ou tri-épineuse, ou coupée carrément avec ou sans épines latérales ; chez les femelles, l'aire pygidiale est très allongée et à pointe aiguë.

Coloration. — Les grandes espèces sont de coloration foncière d'un jaune plus ou moins foncé, avec le thorax noir en grande partie ; les petites espèces sont noires (ou rougeâtres) avec des bandes de couleur claire tran-

chant sur le fond. *Palarus ambustus* est d'un brun-noir. D'après les matériaux à ma disposition, la coloration est assez constante.

Position systématique et affinités :

Le genre *Palarus* a été créé par Latreille en 1802 (Hist. Crust. et Ins., III, p. 336). Il n'y a eu dans la nomenclature qu'un seul synonyme, *Gonius* Panz., 1806, lequel *Gonius* était plutôt une création de Jurine dont la Nouvelle Méthode n'a paru qu'en 1807 ; quel qu'en soit le véritable auteur, *Gonius* a disparu par la suite, il n'en a plus jamais été question.

Cette simplicité dans la synonymie, le genre *Palarus* la doit surtout au fait que pendant très longtemps on n'a réellement connu qu'une espèce, *Palarus flavipes* Fab., d'Europe, les quelques espèces exotiques décrites par Fabricius et Latreille étant méconnaissables.

A vrai dire, le genre *Palarus,* considéré dans son ensemble, n'est pas très homogène ; il est bien défini tant qu'il s'agit des espèces des régions Paléarctique Occidentale et Nord-Africaine, et c'est dans ce cadre qu'il faut prendre les caractéristiques données ci-dessus.

En dehors de ces limites faunistiques, on voit apparaître des modifications qui peuvent avoir une très grande importance. Ainsi, chez des espèces orientales les yeux ne sont plus convergents en dessus de la tête, l'espace qui les sépare augmente sensiblement, les ocelles postérieurs ne sont plus allongés et aplatis, mais deviennent globuleux et arrondis comme l'ocelle antérieur. Or, cette forme allongée et aplatie (dite aussi en forme de virgule) des ocelles postérieurs est un caractère de première importance qui, dans la classification des Sphégides, détermine non pas un genre, mais des groupes de genres !

Les *Palarus* ont été rapprochés des *Nysson*, des *Cerceris*, des *Philanthus*, même des *Oxybelus*, et cette opinion était encore la moins déraisonnable. La vraie place du genre *Palarus* est dans le groupe de genres gravitant autour des genres *Larra* et *Tachysphex.*

Kohl, dans son « *Groupement naturel des Sphégides* » paru en 1896, assigne au genre *Palarus* une place annexe dans son quatrième groupe : *Larra* Fab.. Les affinités du genre avec l'ensemble du groupe sont indéniables, et il n'y a guère moyen de le mettre ailleurs. Il y a bien, de par la constitution spéciale des arceaux abdominaux, quelques rapports avec le genre *Oxybelus*, mais la parenté s'arrête là.

Kohl (loc. cit.), a imaginé de partager les Sphégides en un certain nombre de « Groupes de Genres » (Gattungsgruppe), comprenant chacun plusieurs noyaux ou sous-groupes, autour desquels viennent se ranger les genres plus ou moins aberrants.

Cette conception, étant donnée l'extraordinaire complication des caractères génériques chez les Sphégides, est bien préférable à celle consistant à

scinder cette grande famille naturelle en un certain nombre de familles et de sous-familles, car, avec le grand nombre de genres restant isolés, il faudrait multiplier les sous-familles à l'infini ou leur donner des caractères tellement flous qu'il n'y aurait plus aucune division bien délimitée.

Kohl avait bien compris le fait après la publication du travail auquel j'ai fait allusion au début (*Die Gattungen und Arten des Larriden Aut.*) ; il y avait fait entrer, à côté du genre du Groupe *Larra* actuel, les genres suivants : *Pison* Spin., *Trypoxylon* Latr., *Nitela* Latr., *Solierella* Spin., *Miscophus* Jurine et *Astata* Latr.. On voit d'ici le résultat : aucun caractère ne s'appliquait en même temps à tous les genres et cependant tous ces genres « se tiennent » !

Le genre *Palarus* n'est pas très riche en espèces ; Kohl, en 1896, en comptait une vingtaine, toutes de l'ancien monde, dont 7 ou 8 habitaient l'Europe, le nord de l'Afrique et l'Asie Occidentale ; de ces mêmes régions, on a décrit depuis encore 4 ou 5 espèces, soit une douzaine en tout.

D'Egypte, on connaissait *histrio* Spin., *ambustus*, *laetus* et *lepidus*, tous trois de Klug, *Spinolae* Saussure et *Saundersi* Morice. J'ai retrouvé ces espèces, sauf *lepidus* (et encore peut-être ?) ; je puis y ajouter deux nouvelles espèces, *decipiens* nov. spec. et *eximius* nov. spec.. Les mâles de *Spinolae* et de *laetus* sont assez communs dans les zones cultivées, les femelles de ces deux espèces sont beaucoup moins communes ; quant aux autres elles se trouvent plutôt en bordure du désert et paraissent devoir être rares.

Mœurs :

Pendant longtemps, les mœurs des *Palarus* ont été peu connues. Les individus n'abondent pas comme les *Cerceris* et le *Philanthus ;* les femelles sont généralement très farouches et sont difficiles à observer d'assez près.

Palarus flavipes Fab. capture toutes sortes d'hyménoptères, même des plus robustes (2) ; *histrio* Spin. et *humeralis* Duf. ont été observés par Ferton en Algérie (3) : le premier capturerait principalement des Scolies et des *Polistes*, le second s'en prendrait surtout aux *Halictus* de taille moyenne ou petite, aussi bien mâles que femelles. Le nid est creusé peu profondément dans le sable dur.

Palarus histrio n'existe pas autour de Hawamdieh ; par contre *laetus* y est commun certaines années, et j'ai pu le voir capturer des mâles de *Cerceris subimpressa* Schlett. et de *Cerceris Fischeri* Spin.

J'ai pu assister une fois, à Hawamdieh, à un combat qui devait être

(2) Dufour (*Ann. Soc. Entom. France*, 1841, p. 354).

(3) Ferton : Notes détachées, 7e série (*Ann. Soc. Entom. France*, 1911, p. 365).

bien farouche entre une femelle de *Palarus Spinolae* et un *Stizus* jaune d'assez grande taille, qui malgré son énergique défense, fut maîtrisé et emporté au vol.

Tables pour la détermination des espèces du Genre *Palarus* en Egypte

♂♂

1. Aire pygidiale très allongée, à côtés paralèlles, coupée carrément et légèrement échancrée à l'extrémité .... *Saundersi* Morice

—. Aire pygidiale autrement conformée 2

2. Aire pygidiale allongée, profondément incisée au milieu. Antennes non claviformes, ayant au moins quelques articles dilatés en dessous. Longueur 14 à 17 mm. 3

—. Aire pygidiale courte et large, tridentée à son bord postérieur. Antennes courtes, claviformes. Longueur 12 mm. maximum 4

3. Les deux lobes de l'aire pygidiale sont divergents. Articles 3 à 12 des antennes dentés en dessous. Métatarse I normal ...... *Spinolae* Sauss.

—. Les deux lobes de l'aire pygidiale sont paralèlles. Articles 9 à 11 des antennes renflés en dessous. Métatarse I fortement élargi, le bord postérieur portant des soies spatuliformes .... *decipiens* nov. spec.

4. Coloration d'un brun foncé, éclaircie par places. Ponctuation de l'abdomen forte et serrée, donnant un aspect mat. Longueur 7-8 mm. .... *ambustus* Klug

—. Coloration noire (ou en partie rouge) avec des bandes d'un blanc-jaunâtre en accent circonflexe, sur l'abdomen. Ponctuation moins forte 5

5. Le deuxième sternite porte un callus transversal plus ou moins élevé, occupant toute la largeur du segment; les sternites suivants portant un bourrelet incisé au milieu. Longueur 10-11 mm. 6

—. Face ventrale de l'abdomen lisse, sans callus au deuxième sternite, ni bourrelets bien marqués. Longueur 5.5 mm. ...... *eximius* nov. spec.

6. Plus robuste, la largeur de l'abdomen égale les trois-dixièmes de la longueur totale; bandes claires de l'abdomen faisant nettement saillie sur la surface des tergites. Yeux plus écartés que la longueur du deuxième article des antennes .... *histrio* Spin.

—. Plus grêle, la largeur de l'abdomen égale les deux-dixièmes de la lon-

gueur totale; bandes jaunâtres de l'abdomen plus aplaties, ne se détachant pas de la surface des tergites. Yeux moins écartés que la longueur du deuxième article des antennes .... *laetus* Klug

♀♀

1\. Couleur foncière de l'abdomen jaune ochracé. Longueur 14 mm. au moins 2

—. Couleur foncière de l'abdomen noire ou rougeâtre, avec des bandes d'un blanc-jaunâtre. Longueur 12 mm. au plus 4

2\. Antennes noires à l'extrémité. Ailes jaunâtres, avec une tache grise dans leur tiers extérieur. Plus robuste, largeur de l'abdomen égalant les quatre dix-septièmes de la longueur totale .... *Spinolae* Sauss.

—. Antennes entièrement orangées. Ailes complètement hyalines. Plus élancé, largeur de l'abdomen égalant les trois-quatorzièmes de la longueur totale .... *decipiens* nov. spec.

3\. Deuxième sternite boursouflé de chaque côté, avec un sillon entre les deux protubérances. Plus large .... *histrio* Spin.

—. Deuxième sternite lisse, son bord postérieur très légèrement échancré. Plus étroit .... *laetus* Klug

Manquent dans cette table les femelles de *Saundersi* Morice, *ambustus* Klug et *eximius* nov. spec. qui ne sont pas connues.

Les *Palarus* se partagent en deux groupes, suivant la forme de l'aire pygidiale chez les mâles.

Le premier groupe comprend les espèces chez lesquelles l'aire pygidiale, plus longue que large dans son ensemble, est plus ou moins profondément incisée en son milieu, l'incision pouvant être réduite à une légère échancrure (*Palarus Saundersi* Morice).

Les espèces sont généralement de taille avantageuse, dépassant 13 millimètres; de coloration allant du jaune franc à l'ocre clair.

Le type du groupe serait *Palarus flavipes* Fab. d'Europe, qui est en même temps le type du genre; dans ce groupe viennent se ranger *Palarus Spinolae* Sauss., *Saundersi* Morice et *decipiens* nov. spec.

Dans le second groupe, l'aire pygidiale, plus large que longue dans son ensemble, est tridentée à son bord postérieur, la dent médiane étant plus longue que les dents latérales, dont le développement est variable.

La taille est plus faible, longueur de 6 à 12 millimètres.

La coloration foncière est généralement noire, pouvant passer au rouge,

avec des bandes claires sur l'abdomen ; *Palarus ambustus* Klug, de couleur d'un brun foncé, fait exception.

Palarus Spinolae Saussure, 1854. (Mélanges Hyménoptérologiques, Fasc. I, in *Mém. Soc. Phys. Sc. Nat. Genève*, p. 14).

Le plus puissant de nos *Palarus:* mâle, 14 à 17 mm., femelle 22 mm. de longueur et plus.

Coloration générale ocracée en dessus, devenant très foncée en dessous ; la pointe des mandibules et le vertex sont rembrunis. Le thorax est noir, avec le pronotum, le scutellum et le post-scutellum jaunes ou ocres ; le segment médiaire et la concavité antérieure du premier segment de l'abdomen sont également noirs. Les jointures des segments abdominaux sont très rembrunies, affectant même l'apparence de minces bandes noirâtres légèrement dilatées en triangle au milieu.

Antennes rougeâtres, les deux derniers articles noirs. Pattes jaunes ou rousses. Ailes jaune clair, avec une bande grisaille dans leur tiers extérieur.

Les mâles sont généralement d'un jaune plus clair que les femelles, mais il s'en trouve aussi chez lesquels au contraire le noir envahit le thorax, avec l'abdomen fortement rembruni.

♀.—Le deuxième sternite présente un tubercule conique élevé, tronqué et excavé au sommet, le bord antérieur de la troncature tranchant, le bord postérieur presqu'effacé.

♂.— Articles 4 à 11 des antennes renflés-denticulés en dessous. Le premier sternite offre un petit callus aplati bi-épineux ; le deuxième présente une grande saillie transversale, bombée en arc de cercle régulièrement arrondi, creusée sur sa tranche d'une gouttière dont les bords avant et arrière sont très saillants.

Les bords latéraux du sixième sternite sont relevés en carène, le septième est terminé par un cône aigu, allongé.

Aire pygidiale à lobes divergents, laissant voir en dessous la pointe noire qui termine le septième sternite. Pas de touffe de poils sur les côtés.

Assez commun à Hawamdieh (17♂♂, 4 ♀♀), de la mi-Mai à fin Juin, surtout sur les inflorescences de poireaux.

Palarus decipiens nov. spec.

La femelle ressemble beaucoup à celle de *Palarus Spinolae* Sauss. ; le mâle est voisin de celui de *humeralis* Dufour, 1853, redécrit par Kohl en 1884, pour lequel je l'avais pris au début.

♀.—Facies de *Palarus Spinolae* Sauss., mais s'en distingue facilement. Coloration d'un jaune franc dessus et dessous ; mésothorax noir en dessus

seulement, ainsi que le segment médiaire dessus et sur les côtés; la concavité antérieure du premier segment abdominal rembrunie. Abdomen entièrement jaune, sans traces de bandes foncées aux jointures des segments. Antennes entièrement rousses. Pattes jaunes-roussâtres. Ailes complètement hyalines.

Moins grand et moins robustes que *Palarus Spinolae* Sauss., longueur 14 mm. Ponctuation du mésothorax plus espacée. Le tubercule du deuxième sternite est moins net.

♂.—Coloration comme chez la femelle, plus ocracée. Ailes légèrement jaunâtres, mais sans tache grise.

Antennes à articles à 4 à 8 peu renflés en dessous, 9 et 10 nettement élargis, 11 et 12 le sont aussi, mais moins.

Métatarse des pattes antérieures élargi comme chez *Palarus humeralis* Dufour (Kohl), à bord postérieur festonné et garni de poils spatuliformes très blancs, les articles suivants garnis de longs cils blancs flexibles, et en dessous, de petites touffes de poils noirs, courts.

Premier sternite avec un petit callus bi-épineux. Deuxième sternite offrant une saillie pareille à celle du mâle de *Palarus Spinolae* Sauss., mais dont la bordure postérieure de la gouttière n'est pas régulièrement arrondie comme l'antérieure : vue de profil arrière, elle figure une ligne anguleuse par suite de la présence de quatre dents dont les deux médianes sont les plus fortes et les deux latérales à peine marquées. Le troisième sternite porte une carène transversale tranchante, peu élevée; dans sa description de *Palarus humeralis* ♂, Kohl ne fait pas mention d'une pareille carène.

♂ et ♀ types pris ensemble à Sokhna (littoral de la Mer Rouge), au début de Juillet; je possède encore un autre individu mâle du même endroit.

Palarus Saundersi Morice, 1897.

Décrit de Koubbeh, 4.4.1896, sur un exemplaire mâle.

♂.—Coloration semblable à celle de *Palarus Spinolae* Sauss. sauf en ce qui concerne les antennes qui sont noires, et les ailes à peine jaunâtres, sans tache grisaille. Longueur 12 mm. (Morice indique pour son exemplaire 15 mm.).

Très distinct des autres espèces par son aire pygidiale. Celle-ci est allongée, très étroite dans sa moitié antérieure, un peu élargie dans sa moitié postérieure, la surface est creusée, lisse, brillante; le bord terminal n'est pas incisé, mais seulement très légèrement échancré.

Callus du deuxième sternite comme chez *Palarus decipiens* nov. spec., seulement le bord antérieur n'est pas caréniforme et le bord postérieur est multidenté. Il n'y a pas de carène transversale sur le troisième sternite.

♀.—Inconnue.

Un seul mâle, Abou-Roasch, fin Mai.

Palarus ambustus Klug, 1843.

Décrit de Sakkarah.

♂.—Facile à distinguer parmi les espèces à aire pygidiale tridentée. Coloration d'un brun foncé, avec des taches testacées plus ou moins développées sur les segments dorsaux de l'abdomen. Une tache jaune clair aux angles antérieurs du mésothorax devant les écailles alaires qui sont également jaunes; ces deux taches se retrouvent chez tous les cinq exemplaires examinés. Pattes jaunes roussâtres, les fémurs rembrunis. Antennes rembrunies en dessous, plus claires en dessus, les premiers articles noirs. Ailes hyalines.

Ponctuation générale serrée, surtout sur l'abdomen, donnant à celui-ci un aspect mat caractéristique.

Deuxième sternite muni d'un tubercule en carène transversale.

Aire pygidiale développée en une plaque plus large que ne l'est le tergite précédent; la dent médiane est assez longue, les dents latérales sont fortes, élargies.

♀.—Inconnue.

Trouvé une fois à Kerdacé 5 mâles, au début de Mars, dans une culture de Lupin abandonnée.

Palarus histrio Spin., 1838.

♂.—Coloration noire, devenant rougeâtre sur le dessus des segments abdominaux, d'un brun plus ou moins foncé sur le dessous du corps. Mandibules, clypeus, bord interne des yeux, une ligne inter-antennaire, le bord du pronotum, les écaillettes, deux taches devant et en-dessous de celles-ci, le postscutellum, jaunes. Sur l'abdomen, des bandes jaunâtres, arquées, devenant angulaires sur les derniers segments. Plaque pygidiale jaune. Antennes jaunâtres en dessus, noirâtres en dessous, les premiers articles noirs. Pattes d'un jaune roux, les fémurs tachés de noir. Longueur 11 mms.

Premier sternite avec une petite gibbosité incisée au milieu. Deuxième sternite avec un bourrelet très développé, en arc de cercle, à bord postérieur tranchant.

♀.—Coloration et distribution des bandes et taches coloriées comme chez le mâle, sauf en ce que la coloration foncière de l'abdomen en dessus qui est entièrement rouge. Ailes légèrement jaunâtres. Longueur 12 mm.

Le deuxième sternite ne porte pas de protubérance bien marquée, seulement deux légères callosités, séparées par un sillon médian; ces callosités, légèrement ponctuées sur leur surface, portent sur leur face arrière, deux « miroirs », sous forme de dépressions légères, polies, de couleur noire.

Je n'ai jamais trouvé que deux exemplaires, un de chaque sexe, à Sakkarah, au début de Mai.

Les colorations données ci-dessus diffèrent légèrement de celles données

par Spinola; il y a certainement une certaine variabilité dans le développement de la coloration rouge. Le tout constitue un curieux bariolage, qui explique bien le nom de *histrio* appliqué par Spinola. Je signalerais qu'il y a une bonne figure coloriée de cette espèce dans « Lucas, *Exploration scientifique de l'Algérie*, 1849, planche XII, fig. 7 [♀] de l'Atlas des Hyménoptères.

Palarus lepidus Klug, 1843 (?).

Je possédais depuis longtemps un exemplaire femelle de *Palarus* pris à Dahschour, fin Mai 1931, que j'avais, sans grande confiance, attribué à *histrio* Spin.. La connaissance du véritable *histrio* Spin., et la comparaison avec une grande série de *laetus* Klug (cf. infra), m'ont amené à considérer cet insecte comme étant *lepidus* Klug ♀.

D'abord, sauf quelques détails, de très minime importance dans la coloration, l'exemplaire correspond bien à la description de Klug.

Ensuite, Klug dit : « Spinola Palari speciem huic affinem nomine *P. histrio* proposuit. Feminae descriptio autem, quamvis in multis, non tamen omnino nostrae convenit..., etc. ». Précisément, l'insecte en question ressemble étonnement à *histrio* Spin., mais en est certainement différent.

Un caractère décisif est l'écartement moindre des yeux sur le vertex, écartement réduit de moitié par rapport à *histrio* Spin. ; ensuite, l'aire pygidiale est plus large dans son ensemble et moins aiguë à la pointe ; la ponctuation est plus serrée et donne à l'insecte un aspect plus mat ; enfin le deuxième sternite n'a pas les callosités décrites à propos de *histrio* Spin., la surface du sternite est plane, à peine ponctuée, son bord postérieur échancré au milieu en un angle très ouvert.

Donc cet insecte n'est pas *histrio* Spin. ; il n'est pas non plus *laetus* Klug puisque cet auteur dit de son *laetus* : « Precedenti (*P. lepidus*) proximus, differt praesertim quoad formam corpore graciliore... ». En effet, *laetus* Klug, assez commun à Hawamdieh, est beaucoup plus grèle que *histrio* Spin., et *lepidus* Klug doit avoir le facies de *histrio* Spin.

Si l'individu en question ne se rapportait pas à *lepidus* Klug, il faudrait le considérer comme une espèce non décrite ; il n'est pas recommandable de décrire un *Palarus* femelle sans en connaître le mâle ; je préfère m'en tenir aux conclusions ci-dessus : le considérer comme étant *lepidus* Klug ♀.

Palarus laetus Klug, 1843.

Décrit de Sakkarah et des Pyramides.

♂.—Facies de *histrio* Spin., mais plus grèle et un peu plus petit.

Coloration générale noire devenant plus ou moins rouge sur l'abdomen. Clypeus, côtés du pronotum, angles antérieurs du mésothorax, écaillettes et

différentes taches en dessous de celles-ci, scutellum et post-scutellum ou seulement l'un des deux, taches symétriques, de développement variable, sur les angles et les côtés du segment médiaire, jaunâtres. Sur le dos de l'abdomen, les bandes colorées sont d'un jaune plus intense et sur des bourrelets moins prononcés que chez *histrio* Spin. La plaque pygidiale est jaune ou noire. Antennes d'un brun-jaune sale. Pattes jaunes avec les fémurs et aussi les tibias tachés de noir. Ailes hyalines.

Deuxième sternite avec un callus transversal à arête postérieure tranchante; le troisième sternite porte les rudiments latéraux d'une carène interrompue au milieu.

Plaque pygidiale plus étroite que le sixième tergite, les dents latérales peu marquées.

♀.—Coloration foncière, taches et bandes colorées comme chez le mâle. Antennes plus claires. Pattes jaunes avec les fémurs tachés de brun-clair. Ailes très légèrement jaunâtres sur le disque.

Deuxième sternite lisse, sans aucune protubérance, le bord postérieur échancré.

Assez commun à Hawamdieh (20 ♂♂ et 14 ♀♀), en Mai-Juin.

Klug (loc. cit.) a commis une erreur en supposant que le mâle de *Palarus histrio* Spin. n'appartenait pas à cette espèce mais à *Palarus laetus* Klug, et Kohl, qui ne connaissait de visu aucune des espèces en question, avait trouvé plus simple de mettre *Palarus laetus* Klug ♂ et ♀ en synonymie de *Palarus histrio* Spin. Les deux espèces sont bien distinctes.

Palarus eximius nov. spec.

Curieuse petite espèce, sortant déjà du genre *Palarus*, tel qu'il a été défini plus haut.

Ressemble quelque peu à un très petit *Palarus lactus* Klug. Longueur 5.5 mm.

Noir. La coloration, d'un blanc-jaunâtre, est réduite : le bord inférieur du clypeus, deux petites taches aux angles du pronotum, les écaillettes, le post-scutellum et quatre bandes sur l'abdomen sont jaunâtres ; les pattes sont jaunes avec les fémurs noirs. Antennes d'un brun-roux foncé. Ailes hyalines.

Antennes à deuxième article court et large, le troisième nettement plus étroit que le deuxième et égalant presque deux fois la longueur de celui-ci. Chez *laetus* Klug, les différences dans les proportions de ces deux articles sont beaucoup moins grandes. Aux ailes antérieures, la première nervure récurrente aboutit dans la première cellule cubitale et non dans la deuxième.

La déclivité antérieure du premier segment de l'abdomen n'est pas concave, les carènes latérales de cette déclivité sont réduites à une petite dent.

Les bandes jaunes de l'abdomen sont tout à fait à plat sur les téguments,

les bourrelets plus ou moins prononcés que l'on observe chez *laetus* Klug et *histrio* Spin. ont disparu.

Sternites abdominaux sans aucune callosité, aplanis latéralement, et se raccordant normalement avec les tergites, sans présenter les petits reliefs caractéristiques.

Plaque pygidiale à dent médiane longue, les latérales très réduites.

Type : un mâle, Hawamdieh, 12.9.1933, dans une bande de terrain inculte, sablonneux, près du Nil.

Palarus rufipes Ol. (Latr.) ?.

Spinola, en 1838, décrit sous ce nom un mâle de *Palarus* assez énigmatique. La description s'accorde assez bien avec celle de *Palarus decipiens* mihi, mais Spinola ne fait aucune mention de la forme toute spéciale du métatarse des pattes antérieures, caractère qu'il n'aurait pas pu ne pas remarquer.

Il doit s'agir d'une autre espèce, ou peut-être, d'une coloration spéciale de *Palarus Spinolae* Sauss.

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A Note on the Breeding and Movements of the Desert Locust, *Schistocerca gregaria* Forskal, in Egypt during 1941

[Orthoptera : Acrididae]

by MOHAMED HUSSEIN,
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I. Previous Recent Invasion

The last great invasion of the Desert Locust on this country, from the East and South-East started in 1927, reached its climax in 1930 and came to an end two years later.

In the spring of 1937 many of the northern regions in the Lybian desert faced a minor attack.

Schistocerca hoppers appeared in barley fields and fig plantations near the Mediterranean coast as well as in patches green with desert shrubs to the North of Kattara depression (lat. 30° 20', long. 27° 5').

II. The 1941 Invasion

Since then no alarming news were received until February 1941, when the Sudan Government reported the breeding of this species at Tokar near the Red Sea.

It seems that favourable climatic conditions, which prevailed there during the previous autumn, played an important role in the propagation of solitary *Schistocerca* living in those localities, and the transformation of their progeny into the congregans and migratory types.

Precautionary steps were immediately taken in Egypt.

Late in March a sample of locusts found in a wadi (path of torrents in the desert), 50 miles East of Asswan (lat. 20° 18', long. 33° 52'), was identified as adults of solitary *Schistocerca*.

During April and early May the part of the South-Eastern Desert from Asswan to Shelatin (lat. 33° 7', long. 35° 37') was scouted.

The Desert Locust was found in varying numbers in many wadies between Asswan and Abrag (lat. 23° 22', long. 34° 44'), Wadi-Hamamid (lat. 24° 10', long. 34° 31'), and Kom-Ombo (lat. 24° 28', long. 32° 55').

Dense locust population was however confined to two areas namely Wadi El Kharit (lat. 24° 15', long. 33° 30' to 34° 25') and part of Wadi Garrara (lat. 23° 45' to 24° 10', long. 33° 45' to 34° 5') where desert plants were profuse and more than 20 locusts were found on each plant.

The rest of this district was less infested and the desert region from Abrag to Shelatin near the Red Sea, and thence to Kosseir, harboured no *Schistocerca*. The scanty vegetation in this region indicated the absence of rain for more than one season rendering it unsuitable for locust propagation.

Locusts were found in fairly large numbers only in the wadies bounded on either side by a continuous chain of rocky hillets; rains falling on the slopes soon collect in the sandy bottom and the wadies become green with vegetation.

In the rest of the infested zone, on the other hand, such elevations are far between and plant life depends more or less upon rain falling directly on the plain.

Again there seems to be a strong correlation between locust population and the kind of plant whether annual or perennial, also on the density of growth. In patches green with annual tiny plants, such as *Aristida*, locusts were found in fewer numbers than in localities rich in perennial and full grown desert shrubs like *Zilla*, *Lycium*, *Artemisia* and *Schouwia arabica* (Vahl.).

III. Origin of the present *Schistocerca* outbreak

The actual *Schistocerca* outbreak lies somewhere outside Egypt, in the Sudan or Arabia.

Nothing supports the assumption of local breeding among solitary Desert Locusts inhabiting our regions and their transformation into gregarious. No rain had fallen there for six years previous to 1941, and when inspected in 1937 and 1938 no *Schistocerca* in numbers whatever limited were met with.

In the Sudan and Arabia, on the other hand, conditions were quite favourable for breeding in the autumn of 1940 and the following winter.

Fliers migrating from either region sometime in winter reached the above mentioned regions of Egypt and settled to breed, conditions being ideal after heavy rains.

Judging by the number of the resultant generation, the original swarms must have been small.

Their offspring acquired at the beginning the characteristic features of the solitary type. This may be attributed to their distribution over a wide area where desert plants stood apart giving no chance to the comparatively small number of hoppers to collect and form bands.

Even in the two worst infested zones, namely Wadi El Kharit and Garrara, transformation into congregans and migratory *Schistocerca* was not observed except late after the third and fourth moult or even after the emergence of adults.

The main factors causing these changes were climatic. The hot summer winds had already begun at the time of our visit. Where locust populations were fairly high from the very beginning, their progeny deserted drying plants and took shelter in bands under shrubs still green.

The high temperature and low atmospheric humidity prevailing in those regions made the locusts fretful and restless. Hoppers moved in masses and adults took to wing although for short distances.

Such changes in behaviour were accompanied by others in some of the external features : black markings appeared on the body of the hoppers, fliers assumed the red colour indicating transformation into the congregans and gregarious phases.

IV. Fresh swarms come from the East

The control of locusts at Wadi El Kharit and Garrara came to an end in the first week of June.

But all of a sudden on June 16th, Hurghada (lat. 27° 12', long. 33° 38'), Koseir and other ports near the Red Sea reported the arrival of big fresh swarms from the East.

Two days later they reached not only the desert region East of Asswan but also the cultivated areas of both Kena and Asswan provinces.

A swarm flew as far West as Baris (lat. 24° 35', long. 30° 38'), in Kharga Oasis. Fortunately, the invadors had no chance to remain long. On June 20th, a strong North-Westerly wind carried them off and few days later reports indicated their arrival to the northern provinces in the Sudan.

As previously mentioned, actual observations and information collected from local arabs supported the theory that locusts found breeding in the desert East of Asswan must have come from the Sudan or probably from Arabia.

On the other hand, the swarms reported from Hurghada and other ports on June 16th, 1941, were actually observed coming from the East. Undoubtedly they were the progeny of a generation produced in Arabia.

News received from the Egyptian Legation at Jedda in Hedjaz confirmed this point for locust appeared in great numbers at Taif, Mecca and

Medina. About the middle of June the situation became critical, but soon afterwards the swarms departed westwards in the direction of the Red Sea.

Reports received from other sources indicated the breeding of the Desert Locust in Yemen, Aden, Hadramut, Sudan and Eritrea.

Such new developments, as the Central Locust Bureau of London mentions, are sufficient warning that a new cycle of *Schistocerca* has already started demanding a cooperative and effective system for reconnaissance and control by all countries concerned.

Le brachyptérisme de la Courtilière

[Orthoptera : Gryllotalpidae]

(avec 1 Tableau Hors-Texte)

par ANTOINE CASSAB

L'origine de mes recherches sur le problème gryllotalpien remonte au mois d'Avril 1933. Depuis, chaque année au début de Mars et jusqu'en Octobre 1940, un grand nombre de parcelles de terre ont été bêchées dans tout le pays et les courtilières mises à jour ramassées par milliers. Ces opérations sont suspendues de Novembre à fin Février, époque durant laquelle les courtilières hibernent dans leurs galeries souterraines à une profondeur pouvant atteindre jusqu'à un mètre cinquante. Il est alors fort peu aisé de rechercher ces insectes.

L'étude de l'énorme matériel recueilli au cours de ces huit années, environ 34000 individus adultes, a permis :

(1) De confirmer l'existence en Egypte de deux espèces de courtilières, soit :

(a) *Gryllotalpa gryllotalpa* Linné (=*vulgaris* Latr.) et sa forme brachyptère (=var. *cophta* De Haan).

(b) *Gryllotalpa africana* P. de Bauv. dont la forme brachyptère, découverte en 1938, a été récemment décrite [1].

(2) De fixer la répartition des deux espèces dans les différentes parties du territoire.

Cette question a été traitée par l'auteur dans un précédent article [2].

(3) De déterminer la fréquence des sexes.

Nous avons constaté que les femelles prédominent dans la proportion de cinq à deux.

(4) Enfin, d'établir le pourcentage des individus macroptères et brachyptères.

(1) Antoine Cassab : Sur une forme brachyptère inédite de *Gryllotalpa africana* P. de Bauv. (*Bulletin de la Société Fouad I^er^ d'Entomologie*, vol. XXIV, 1940, pp. 181-182).

(2) Antoine Cassab : Les Courtilières de l'Egypte (*Bulletin de la Société Royale Entomologique d'Egypte*, vol. XVIII, 1934, pp. 421-426).

La plus ancienne référence que nous possédons sur l'existence en Egypte de la forme brachyptère de *Gryllotalpa gryllotalpa* L. nous est fournie par J.C. Savigny. Cet auteur en a publié une bonne illustration (fig. 3²) dans la « Description de l'Egypte » (Atlas Histoire Naturelle, tome II, 1826, Zoologie : Orthoptères, Planche 3 [dessinée et gravée en 1806-1812]). *Gryllotalpa africana* P. de Bauv. figure également sur la planche (fig. 3¹). La forme typique (macroptère) de *Gryllotalpa gryllotalpa* L. n'est pas illustrée, première indication qu'à cette époque elle était tout au moins bien moins fréquente que la forme brachyptère figurée par Savigny et décrite bien plus tard, par De Haan, en 1842, sous le nom de variété *cophta*.

Ainsi donc, nous savons définitivement que la forme brachyptère de *Gryllotalpa gryllotalpa* L. existe en Egypte depuis au moins 135 ans, puisque la planche de Savigny date de 1806. Si nous ne possédons aucun renseignement sur sa fréquence à cette époque, nous sommes cependant convaincus quelle y prédominait.

Willcocks et Bahgat [3] ont été les premiers à signaler que la forme brachyptère de *Gryllotalpa gryllotalpa* L. est de beaucoup plus commune aux environs du Caire que la macroptère. Nous avons constaté qu'il en est de même dans toute l'étendue du pays : la forme brachyptère prédomine dans les proportions qui sont indiquées sur le Tableau qui termine cet article.

Depuis Savigny, le système d'irrigation, les méthodes culturales, l'intensité et la diversité des cultures ont subi une évolution considérable, modifiant dans une certaine mesure le climat du pays. Ces divers facteurs sont cependant beaucoup trop récents et n'ont certainement pu altérer la morphologie de nos courtilières. Tout au plus ont-ils contribué à une plus grande propagation et dispersion de ces insectes sur toute l'étendue du territoire, à leur adaptation aux conditions nouvelles sans doute plus favorables que celles d'autrefois.

Notre Tableau confirme bien ce qui précède. En effet, il indique que *Gryllotalpa gryllotalpa* L. et sa forme brachyptère sont actuellement distribués dans toutes les provinces, malgré la nature diverse des terres et le régime hygrométrique du pays.

La forme brachyptère de *Gryllotalpa africana* P. de Bauv. s'annonce en 1938, uniquement dans les provinces de Dakahlieh, Calioubieh et Ghizeh. Il est sans doute prématuré de se prononcer sur la possibilité de la voir prédominer à l'avenir sa forme macroptère.

Cependant, l'étude des pourcentages de notre Tableau révèle un détail

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(3) Willcocks et Bahgat : The Insects and related Pests of Egypt : Insects and Mites Injurious to the Cotton Plant (vol. I, part 2, 1937, page 147 [Royal Agricultural Society, Cairo]).

bien troublant : les individus brachyptères de *Gryllotalpa gryllotalpa* L. et de *Gryllotalpa africana* P. de Bauv. sont en augmentation progressive à partir de 1933 et 1938 respectivement. Comment expliquer cette mutation de la forme macroptère à la forme brachyptère ? Quels sont les divers facteurs susceptibles d'engendrer une altération aussi profonde ?

Willcocks et Bahgat (loc. cit.) estiment que l'Egypte, de par son système d'irrigation pérenne fort développé, constitue un pays éminemment favorable à la courtilière si friande d'humidité. Ils se demandent si la typique *Gryllotalpa gryllotalpa* L. n'est pas en voie de se transformer en forme brachyptère et si, avec le temps, elle ne sera plus qu'une espèce totalement aptère !

Certes, la théorie biologique de l'évolution admet la transformation progressive des espèces à travers les âges. Ainsi, nos deux espèces de courtilières et leur forme brachyptère dérivent incontestablement d'une *seule* forme ancienne *différente* qui existait à une époque géologique antérieure à la nôtre. A quelle époque remontent nos espèces et formes actuelles ? Nul ne saurait le dire ! Nous sommes en présence de l'ancienne forme, actuellement polymorphe. Les auteurs modernes, pour la convenance de l'entomologie systématique, ont assigné à ces formes des noms qui permettent de les distinguer entre elles.

Tenter d'expliquer l'origine et les causes du brachyptérisme de nos courtilières sur la base de théories hasardeuses serait se fourvoyer sur le terrain dangereux de la spéculation. Ainsi, les pourcentages de notre Tableau, établis sur une récolte intense de courtilières jamais égalée auparavant, n'interprètent que le résultat de nos constatations.

BRACHYPTÈRE

Antoine Cassab

PROVINC	...otalpa ...cana	1939 POURCENTAGE *Gryllotalpa gryllotalpa*		1939 POURCENTAGE *Gryllotalpa africana*		1940 POURCENTAGE *Gryllotalpa gryllotalpa*		1940 POURCENTAGE *Gryllotalpa africana*	
	Forme brachyptère	Forme macroptère	Forme brachyptère	Forme macroptère	Forme brachyptère	Forme macroptère	Forme brachyptère	Forme macroptère	Forme brachyptère
Alexandrie	—	0.48	99.52	–	—	0.16	99.84	—	—
Port-Said	—	1.08	98.38	—	—	0.67	99.33	—	--
Suez	—	1.75	95.99	2.26	—	1.00	96.14	2 86	—
Damiette	—	0.92	99.08	—	—	0.69	99.31	—	—
Gharbieh	—	4.11	91 16	4.73	—	2.53	92.84	4.63	—
Sharkieh	—	5.03	90.77	4.20	—	3.06	92.06	4.88	—
Dakahlieh	0.82	6.39	88.29	3.81	1.51	3.79	90.23	3.90	2.08
Menoufieh	—	7.42	92.58	—	—	5.01	94.99	—	—
Béhéra	—	0.81	99.19	—	—	0.62	99.38	—	—
Calioubieh	0.72	5.71	90.07	3.04	1.18	3.02	92.27	2.99	1.72
Ghizeh	0.94	3.20	78.13	17.45	1.22	2.03	79.74	16.26	1.97
Béni-Souef	—	13.54	62 20	24.26	—	9.07	66.80	24.13	—
Fayoum	—	7.16	50 65	42.19	—	5.21	51.87	42.92	—
Minieh	—	11 05	61.12	27.83	—	8.01	64.96	27.13	—
Assiout	—	11.78	60.53	27.69	—	9.08	63 19	27.73	—
Guirgheh	—	10.91	55 03	34.06	—	7.13	59.75	33.12	—
Kéna	-	11.09	58.87	30.04	—	9.01	60.97	30.02	—
Assouan	—	11 63	56.24	32.13	—	10.02	57.89	32.09	—

Note on the Poison-bait used in Egypt for controlling Locusts and Grasshoppers

by MOHAMED HUSSEIN
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Sodium arsenite is used extensively in Egypt in the preparation of poisoned bran-baits for combatting the Desert Locust, *Schistocerca gregaria* Forsk., as well as many indiginous species of grasshoppers, mainly the berseem (*Trifolium alexandrinum*) grasshopper, *Euprepocnemis plorans* Charp., and the rice grasshopper, *Aiolopus strepens* Latr..

The formula of the bait is :

Sodium arsenite	2.5 lbs.,
Water	2.5 litres,
Molasses	4.5 litres.

The first ingredient should contain no less than 82 % water soluble arsenious oxide ($AS_2\ O_3$) and molasses 45 to 50 % of cane sugar.

This concentrated poison is diluted at the rate of 1 : 15 of water; one diluted litre is sufficient for moistening about 0.9 lbs. of wheat bran. Thus, a ton (1000 kilogrammes) of bran requires 1125 litres containing 27.5 lbs. of sodium arsenite (= 12.375 kilogs.).

With the exception of emergency cases which necessitate the preparation of the concentrated poison bait on the spot, this solution is stored in drums or tins of different capacities and when required it is added to the bran after being diluted at the proportions already given.

It was found, however, that storage has a pronounced bad effect on the solution; chemical reactions take place separating the soluble arsenious oxide of the sodium arsenite into insoluble arsenious or arsenic oxide.

The longer the concentrated solution is kept the less effective it becomes. Samples taken from a 4 gallons tin were analysed after about 3 years storage. Half their original content of soluble arsenite was converted into insoluble arsenious oxide.

Many difficulties were moreover encountered in transporting molasses

or the prepared solution to the field, more especially to desert regions. Some authorities advocated the addition of molasses to the bait as a locust attractant.

Experiments were carried out during the last three years at Dokki by the Locust Research Sub-Section of the Entomological Section to ascertain this and two other points:

(1) To find out the minimum lethal dose of sodium arsenite for adults and for the different nymphal instars of the three species already mentioned.

(2) To find out the quantity of diluted solution necessary for moistening a certain weight of bran.

Space does not allow giving details of the technique of work followed.

Briefly speaking, laboratory experiments were conducted on locusts and grasshoppers kept in breeding cages of different dimensions and in partitions of the big locust cage covering an area of about 750 square metres. No food was given 12 hours before giving them bait.

The bait was applied in the morning sometime between 7 and 9 varying with the seasons. These are the morning hours on which locusts and grasshoppers start feeding (Temp. 20° C.).

Field experiments were carried out when *Schistocerca gregaria* Forsk. invaded and bred in some localities of the South-Eastern Desert in the vicinity of Asswan. Bait with no molasses was applied on a small scale; the large quantities of the sweetened concentrated solution which remained from the 1937 invasion had to be used for their control.

Results so far achieved show that:

(1) Molasses cannot be regarded as an essential ingredient in the poisoned bait.

The bait made from wheat bran, sodium arsenite and water gave as high percentage of mortality as the bait with molasses.

In both cases, the sodium arsenite was added at the rate of 1 : 100 of wheat bran and the mixture was thoroughly moistened with water.

(2) When dealing with *Schistocerca* hoppers in the first two nymphal instars, 0.5 gram of sodium arsenite added to every 100 grams of bran gave a good mortality after 72 hours in the majority of cases and after 48 in some experiments.

This was also observed with hoppers of the same stages in *Euprepocnemis plorans* Charp. and *Aiolopus strepens* Latr..

(3) As regards the quantity of water added to the bait it was found that no less than 1.5 c.cms. of water should be added to every gram of wheat bran.

It seems that water plays an important role in attracting the hoppers and locusts especially in desert regions.

In 1928, while combatting both these species of grasshoppers in the

Dakhla and Kharga Oases in the South Eastern Desert, I noticed that hoppers and adult grasshoppers hardly fed on the bait which had become dry by the strong wind.

In some of the experimental cages bran was remoistened and the insects soon devoured it.

The same observation was made in the Sinai Peninsula during 1930 invasion when barriers of bran bait (containing molasses) were scattered in the path of the marching hopper bands. On becoming dry, water had to be sprinkled over them to induce these creatures to feed on the bait.

Finally, reference should be made to another substance used instead of sodium arsenite, namely sodium fluosilicate.

The importation of sodium arsenite under the present war conditions became very difficult and a substitute of this material had to be used.

Several experiments carried out with sodium fluosilicate have definitely shown that it can be regarded as a good substitute. The dose used is however high.

Experiments have so far shown that for *Schistocerca* hoppers in the first and second stages the proportion should be 2 : 100 of bran.

For hoppers in a more advanced stage and adults 4 : 100 must be used.

Further experiments are being carried out.